



Response to Department of Planning Comments for Black Springs Wind Farm Environmental Assessment

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Project: **Response to Department of Planning Comments – Black Springs Wind Farm**	
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RESPONSE TO DEPARTMENT OF PLANNING COMMENTS

Pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979*, the Environmental Assessment for the proposed wind farm at Black Springs NSW was placed on public exhibition from Thursday 25 January 2007 until Friday 9 March 2007, at the following locations:

- **Department of Planning**
  Information Centre, 23-33 Bridge Street, Sydney

- **Oberon Shire Council**
  137-139 Oberon Street, Oberon

- **Oberon Library**
  Corner of Dart and Fleming Streets, Oberon

- **Black Springs General Store "Charlie's on Abercrombie"**
  Abercrombie Road, Black Springs

- **Oberon Visitor Information Centre**
  48 Ross Street, Oberon

A copy of the Environmental Assessment was also placed on the Department of Planning website: www.planning.nsw.gov.au

A total of 85 submissions were received by the Department of Planning, with 79 from the community, 1 from Oberon Council and 5 from Government agencies. A separate response document has been prepared in response to the relevant issues raised in the submissions.

A site visit was conducted with the Department of Planning and representatives for the proponent on Friday 20th April 2007. The site and the surrounding area were visited to provide the Department of Planning representatives an appreciation of the site.

The Department of Planning has also prepared their own comments following a detailed review of the Environmental Assessment. Below is the proponent's response to the relevant matters raised by the Department of Planning.

Black Springs Wind Farm Environmental Assessment (EA) – Comments

<u>Chapter 2</u>

- *description – information on the substation/facilities building should be provided – scale, design etc;*

A plan illustrating the substation location, size and a photograph of a representative facility has been prepared.

- *p. 3 – states that the turbine design is indicative only, and could change. Any changes must be within the 'impact envelope' addressed in the EA, otherwise it may not be the same proposal;*

The final turbine chosen for the site will comply with the impact envelope as assessed in the Environmental Assessment and with the determination of the Department of Planning.

- *p. 6 – reference to 'industry standards and Council's construction hours of operation guidelines' is not helpful – the actual hours proposed should be stated;*

The proposed hours of operation are 7am to 7pm Monday to Saturday, with a work force of approximately 50 workers. No works are proposed for Sunday.

- *p. 16 - the CEMP outline is very limited – many relevant issues are missed eg management responsibilities, noise, community, flora and fauna, heritage, dust. It is noted that the CEMP is also described in section 8.1, and more issues are identified (but still incomplete).*

The Environmental Assessment states that the CEMP will be prepared prior to construction. The outline listed on p. 16 and in Section 8.1 are only guidelines that provide background regarding the content of the CEMP. A comprehensive CEMP and OEMP will be prepared incorporating all issues identified in the outline as well as issues and management methods recommended by the relevant Government agencies. The CEMP and OEMP will scope in detail the environmental management issues and then detail objectives, mitigation methods, measurable tasks to prevent or ameliorate impacts, person responsible for implementing tasks, how tasks are to be completed and the timeframe for completion. The CEMP and OEMP will also follow the philosophy of adaptive management. The philosophy of adaptive management is followed when policies and practices are continually improved by learning from the outcomes of previous work. The process is iterative and aspects of the management process are revisited and reviewed. As part of the adaptive management process the management measures provided by the CEMP and OEMP will also include a review and assessment program where works and monitoring is regularly reviewed and reassessed to ensure the environmental outcomes are achieved.

- *p. 18 – s 2.8.6 – this justification is quite limited – much is made of the reduced scale of the proposal. This is not really relevant – we are looking at the proposal as it stands, not some other proposal that may have once been thought about. MRETs are probably already met. Why are Suzlon turbines more suitable for dealing with hazards such as storms or fires? Also, the EA does not appear committed to Suzlon – if they are not installed will there be a greater risk?*

Section 2.8.6 Preferred Option Justification refers to why the project in its current form. Accordingly, it is considered appropriate to highlight the original 33 turbine proposal with many turbines planned for ridge tops as this was an alternate option that was previously examined. As the proponent understands the Department of Planning is only examining the proposal in its current form, but in justifying the preferred option, consideration of the alternate options and why the preferred option was selected over the alternatives, is appropriate to highlight.

Wind turbines differ in design and capability for different environments. Different turbines are produced for a range of environmental conditions, climatic conditions and wind speeds. The Suzlon turbine is suited to the wind conditions and climate found across the proposed site. The use of the Suzlon S88 as a generic model of the proposed Black Springs Wind Farm ensures maximum generation is derived from the site, whilst maintaining system reliability and minimising operations and maintenance costs. The S88 turbine serves as an excellent model for modelling the wind farm layout, energy generation and in minimising any potential impacts. The model is considered reliable in similar climates with similar hazards including storms and fires, which contributed to the models selection. Should a turbine produced by another manufacturer be selected an identical risk profile will be maintained with respect to natural hazards such as fire and storms.

- *p. 20 – conservation of biological diversity etc – there is no mention of bird/bat strike.*

As part of the consideration of conservation of biological diversity and ecological integrity, the potential for bird/bat strikes was assessed and considered not a significant threat. Measures to assess the impact of any bird/bat strike are listed in the Flora and Fauna Assessment. In addition, as part of the adaptive management process the monitoring and ongoing assessment of the threat level will be reviewed and appropriate changes incorporated where necessary. Accordingly, these measures will contribute to the proponent's commitment to employ the principles of Ecological Sustainable Development.

<u>Chapter 3</u>

- *p. 24 – a more definitive statement on consistency with the DCP would be desirable and should be provided.*

Overall, the wind farm proposal complies with the objectives of DCP O. The matters of concern expressed by Oberon Council regarding non-compliance with DCP O are addressed in the following points and outline how the project relates to the specific clauses in DCP O:

  - *Dwelling closer than 750m from turbine 8*

The non complying dwelling located closer than 750m from turbine 8 is the Miller residence. The Miller residence has a contractual arrangement with the wind farm and is therefore considered an associated residence in the development, in accordance with the requirements of Clause 9h. The wind proposal therefore complies with Clause 9h.

  - *Requires a viewing area*

Item 3 of the Draft Statement of Commitments within the Environmental Assessment, outlines that a viewing area incorporating educational signage will be established to create a safe viewing location for the public. The wind proposal therefore complies with Clause 9j.

  - *Turbine 7 needs to be 149m from Campbell's River Road*

Turbine 7 is located 140m from Campbell's River Road, 9m less than the 149m required by DCP O. Therefore, the wind proposal does not fully comply with the requirements of Clause 9k. The purpose of the Clause is to maintain rural aesthetic amenity and minimise any potential traffic conflicts. The difference of 9m in this circumstance is not considered significant as it will not result in any additional impacts on the rural aesthetic amenity or result in any additional potential traffic conflicts.

  - *Requires legal agreement that turbines will be removed on decommissioning*

Under the Part 3A process, the Minister for Planning will decide whether to grant approval or not for the project. The Minister's approval will also outline any conditions that may be imposed with the approval. Pursuant to Clause 75J (5) of the *Environmental Planning and Assessment Act 1979*, the conditions of approval may require the proponent to comply with any obligations in a statement of commitments made by the proponent. Accordingly, Item 26 of the Draft Statement of Commitments within the Environmental Assessment outlines that the wind turbines and associated above ground infrastructure will be removed and the site restored within 12 months of the project being decommissioned. Additionally, the turbines will be removed at the proponent's expense upon decommissioning. This has also been stipulated in the relevant Lease Agreements with the participating Landowners.

Chapter 4

- *p. 27 –the Director-General's requirements (DGRs) should have provided the base for the issues to be considered;*

The DGR's did provide the base for the issues to be considered though this was not listed specifically. Reference to the issues raised during the consultation process was meant to incorporate the DGR's. Admittedly, mention of the consideration given to the DGR's should have been written.

- *P. 27 – table 5 – what about aviation, interference, property values?*

Table 5 lists the environmental issues as listed in Section 5 of the Environmental Assessment. Aviation and interference are incorporated under Section 5.8 Infrastructures and Utility Issues and Property Values under Section 5.10 Socio-Economic Issues.

Chapter 5 (and subject appendices)

- p. 28 – what is the difference between positive/negative and beneficial/adverse?

The intention of including positive/negative and beneficial/adverse was to provide an allowance for whether an impact was positive or negative on the environmental issue in question and to allow that positive or negative impact to be determined whether it will have a beneficial or adverse impact on the environment. For example, electromagnetic interference has the potential to have a negative impact on the television reception of local residence or on the VHF signal for Black Springs – Burraga Fire Tower, but this negative impact will not have a direct adverse impact on the environment.

- p. 31 – basis for claiming 47,000MWh i.e. can substantiation be provided for the capacity factor used?

The Energy Calculation Report details how the projected generation and capacity factor relate and how they were calculated.

- *p. 31 – claim that the WF will power 6000 houses, satisfying the power requirements of Oberon etc is misleading. It may well produce the amount of power these towns use on average, but it can't meet their requirements by itself, because of the intermittency of wind;*

It is anticipated that the wind farm will produce enough electricity to power the equivalent of 6000 homes, equivalent to the power requirements of Oberon, Black Springs and Burraga. The statement was incorporated to demonstrate the generation capacity of the wind farm and in no way was it intended to mislead the reader. Although it is correct that the requirements cannot be met at all times due to the potential difference between the generation profile of the Wind Farm and the load profile of Oberon on average the electricity produced is similar to the average consumption of 6,000 homes. Due to the connection to the local transmission network at 66kV the electricity produced in the Black Springs Wind Farm will mainly be consumed in the local area of Oberon.

Landscape and Visual Issues

- *p. 33/34 – section 5.2.1 – need some conclusion on the value of this landscape, and its significance;*

A conclusion on the Scenic Quality value is provided in the Visual Impact Assessment, Section 4. The overall scenic quality of the visual catchment and the broader area is predominately a moderately modified landscape where approximately 90% of the area has been cleared with small areas of remnant woodlands. Characteristic elements of the landscape include large cleared grassland areas with some shade trees. A number of engineered or built structures exist within the site and the immediate vicinity. The landscape does not contain any significant regional features, ridgelines or mountains. It is considered the landscape is representative of the typical landscape across the region and holds no high level of significance.

- *p.34 – section 5.2.3 – not clear how close the nearest non associated dwellings will be – are they the Black Springs village dwellings, or are there some other dwellings that might be closer?*

The nearest non associated dwellings are listed in Section 6 of the Visual impact Assessment. The 'Winton Park' farm residence is approximately 1100m to the east and the 'Kalgoorlie Hall' farm residence approximately 1100m to the south of the closest turbines. The Baxter residences are located further away to the south of the wind farm beyond 'Kalgoorlie Hall'. The 'Mount Bathurst' residence is located approximately 1800m from the most northern turbine.

- *p. 35 – section 5.2.5 – compatibility depends on the area's existing values, which were not properly addressed in section 5.2.1;*

Section 5.2.5 relates to the compatibility of wind turbines with the existing landscape. Wind turbines are not new structures to the rural landscape. After the 1930's, some isolated rural communities used wind turbines to create direct current electrical power. To maximise the potential of a wind farm, they require a good wind resource and a large expanse of land to provide adequate spacing between turbines. Wind turbines are ideally suited to rural landscapes as they harvest the energy provided by wind across large areas though they only occupy a small footprint. This combination of the need for large areas though only occupying a small footprint is provided in the rural landscape with minimal impact on farming operations. Cropping or stock can occur right up to the base of each turbine. Therefore the turbines are fully compatible with current land use practices and the existing landscape.

- *p. 36 – section 5.2.7 – what about glint?*

Blade glint is addressed in Section 9 of the Visual Impact Assessment. The colour and finish of the turbines has been designed to have the least visual prominence in the landscape and mitigate sun reflection concerns. A matte finish for the turbine blades, tower and nacelle will be incorporated to reduce the potential for blade "glint".

- *p. 37 – indicates some residences will be impacted visually, but the EA does not address whether these impacts on individual residences are acceptable or not;*

The impacts on the 'Kalgoorlie Hall' and Swatchfield residences are considered acceptable for the following reasons:

- the turbines have been arranged in a linear layout with respect to the affected residence to reduce the visual prominence of the wind farm;
- the viewshed impacted upon by the wind turbines only forms a small part of the total 360° viewshed from these residences (62° of the viewshed for 'Kalgoorlie Hall' and 42° for the Swatchfield residence);
- the orientation of both Swatchfield residences is towards the east, not towards the wind farm;
- the orientation of the 'Kalgoorlie Hall' residence is towards the east, though some living areas are orientated toward the north and the wind farm;
- existing vegetation adjacent to the 'Kalgoorlie Hall' residence and a wind break along the property boundary reduces the view towards the proposed turbine sites;
- additional landscaping measures will provide appropriate screening of the wind turbines and has been offered by the proponent to further reduce any potential visual impacts.

It is considered that none of the non participating properties are in any way severely impacted. It is acknowledged that the Swatchfield and Kalgoorlie residence have an effect but the visual impact alone is not considered to be a severe impact. Considering all of these factors, the visual impact on the residences is acceptable.

- *p. 37 – 2nd para – refers to overall benefits of the wind farm. Whilst this may be correct, it is not really a conclusion on visual impacts as such;*

The wind farm will have a visual impact on the local area due to the height of the turbines. An assessment of the impacts on adjacent residences concludes that there is the potential for the turbines to have a high visual impact due to the latent long viewing times, however, the visual impact is considered acceptable in this circumstance for the reasons stated above.

The Black Springs landscape is typical of the wider landscape of the region and contains no significant regional features. The existing landscape is highly modified due to agricultural and forestry practices which continually result in changing vistas primarily due to forestry operations. The stark impact of clear felling logging operations features prominently in the local landscape and contribute to the agricultural working relationship of the land and the visual landscape. The 450kV transmission line traversing the area as well as existing farm buildings also contribute to the modified nature of this landscape. The wind farm has the potential to impact the wider visual catchment, though not on the large scale that results from the current forestry felling practices. The wind farm proposal only covers a small footprint and will not dominate the wider regional visual landscape, because as the distance between the viewer and the wind turbine increases the visual prominence decreases. In comparison, the clear felling of forests can be observed from much greater distances. Therefore, considering the continual changes to current landscape from forestry practices and the high modification from the original landscape due to agricultural practices, the potential impact of the wind farm on the regional landscape is considered low. Additionally, the environmental benefits associated with renewable energy also provide significant positive aspects and the impacts in this circumstance can be mitigated to a level where the environmental benefit outweighs the wider potential visual impact.

- *no mention is made of any approved dwellings – as required by the DGRs. Are there any?*

Vicky McKinon from Oberon Council has confirmed that no development application or approval for the subdivisions adjacent to the wind farm site has been received or approved.

- *Appendix B (Visual Impact Assessment). Comments and questions include:*
    - *p. 3 – construction and completion dates are a bit misleading;*

Construction timing is dependant upon receiving approval for the project from the Minister and the timing of the decision. Should an appeal to the decision be made, this timing would extend further. Ideally, construction would commence six months after an approval and take approximately six months to complete.

- *p. 4 – would off white/light grey be a more appropriate colour than just white?*

The wind turbines would be off white.

- *p. 5 – the overall visual quality methodology does not distinguish between what is meant by 'visual quality' (medium to high) and 'scenic quality' (moderately modified);*

Section 4 Scenic Quality states that 'visual quality' relates to the landscape within the visual catchment and the 'scenic quality' refers to the visual catchment and the broader area. It is conceded that the use of the words scenic and visual may result in some confusion, though this was not intentional. The terms in this case are not interchangeable and are only meant to relate to the visual catchment and to the broader area to assist in the explanation of the viewshed surrounding the project.

- *p. 7 – while there may be other engineered structures in the landscape, none would be anywhere near as tall as the proposed turbines;*

The presence of existing prominent engineered structures contributes to the degree of modification of the landscape. While the transmission lines may not be as tall as the turbines, they do extend across a vast area of the landscape. The existing 500kV towers are approximately two thirds of the hub height of the turbines. It is considered important to identify all existing engineered structures as part of the assessment as this provides a holistic assessment of the visual environment.

- *p. 8 – not clear what the reference to the artistic values of Black Springs is supposed to be saying;*

The DGR's required the visual impact assessment to be prepared with regard to the Australian Wind Energy Association and Australian Council of National Trust's *Wind Farms and Landscape Values: Stage 1 Final Report – Identifying Issues, March 2005*, with particular emphasis on Appendix B: *Wind Farms and Landscape Values: Final Issues Paper*, the *Draft NSW Wind Energy Environmental Impact Assessment Guidelines* (Department of Planning, 2002). In accordance with the Landscape Values Report, an assessment of the artistic values of the area must be undertaken (representation of the area in art). This incorporated a review of any photographs, paintings and other artistic media to determine if the area is representative of a significant artistic landscape. Therefore, as part of the assessment the artist values of Black Springs was researched and recorded. The underlying result is that Black Springs is not recorded in any significant artistic media and that the development of a wind farm will not significantly impact upon the artistic culture of the area.

- *p. 9 – reference to vegetation influences – does this take account of pine forests being logged, and therefore reducing their screening value? (though such activities may also reduce the area's landscape values, enabling turbines to be more readily 'absorbed' into the landscape);*

Harvesting of the forestry resource within the Black Springs region may have the potential to partially influence the visual presence of the proposed wind turbines. However, as the turbines are proposed to be 144m above ground level, the impact that any forestry would have directly adjacent to the wind farm would be minimal with respect to views towards the wind farm where forestry is either part of the middle and/or background vista, as the turbines would be visible above any forestry located around the wind farm. Forestry harvesting would have a greater impact where the forest is located close to the viewing location and where it currently screens views. However, in these circumstances the wind farm would form only a part of the landscape view at such a distance. Only one house is currently located adjacent to the wind farm with Forestry directly between the residence and the site. This house is located near the base of a hill sloping away from the wind farm and has extensive planting located around the dwelling. It is not expected that the wind turbines will be visible due to the topographical influence of the landform plus the existing screening vegetation. Therefore, the influence of forest harvesting is considered to be minimal on the visual impact of the wind farm.

- *p. 22 – stating that the landscape is secondary to those working the land has met with a negative response from communities in some other areas. Also, to what extent is the area/population changing, so that landscape values may be of greater importance?*

Some of the larger landholdings in the area are currently being subdivided into smaller rural parcels, though in general these parcels are still of significant size (>40acres). There exists the potential for Black Springs to expand with the creation of rural lifestyle blocks adjacent to the village, which could contribute to the current population and introduce alternative values to the landscape. However, the landscape and its occupants in its current form are predominately agricultural based farmers and it is difficult to speculate on the potential landscape values that a future population may hold. It should be noted that a change in the population after the establishment of the wind farm, where new residents move into the area could result in a greater value placed on the wind farm in the landscape, as residence would move to the area with the full knowledge of the wind farm operation, though again this is difficult to ascertain, as it is speculative.

- *p. 22 – relevance of wind mills? They bear little resemblance to a modern wind turbine;*

Wind turbines are not new structures to the rural landscape. After the 1930's, some isolated rural communities used wind turbines to create direct current electrical power. Therefore, the historical association of previous forms of wind mills for power generation is relevant. As with most technology, over time the form and function changes and the conversion from the traditional wind mill to the modern wind turbine is no exception. Just because the resemblance changes, the historical association is still relevant.

- *p. 24 – no real consideration given to the effect shadow flicker could have on drivers;*

Shadow flicker is influenced by the position of the sun through the day and through the year, turbine orientation and the absence of significant levels of cloud. Shadow flicker influences on road users may occur at certain times of the day through out the year. The potential for shadow flicker to distract a driver exists, though the impact is not considered significant. Thousands of cars travel passed the Kooragang Island wind turbine every day without incident. The turbine is situated less than 100m from the road. Shadow flicker across the road only occurs at certain times of the year in the early morning and late afternoon. However, the degree of shadow flicker is influenced by the prevalent wind direction and resulting orientation of the turbine.

Cormorant Road carries industrial traffic to Kooragang Island, which is the principal heavy industry area in the Newcastle region and also carries peak hour traffic to and from Newcastle and to the major residential areas to the north including Stockton peninsula and through to Port Stephens and Nelson Bay. The presence of shadow flicker across the road does not impact on the usability of the road. A request has been made to the RTA to assess the traffic incident rate for Cormorant Road and to advise whether any significant increase in incident levels is associated near the location of the turbine, and if any of the incidences were related to shadow flicker. This assessment will be forwarded when complete. To mitigate any potential impacts, caution signage will be erected along Campbell's River Road to inform drivers that they are approaching the wind farm site. This will pre warn drivers of their approach to the wind farm and allow drivers to be prepared for the visual impact.

- *p. 24 – refers to a 50mm film camera. Plate 6.13 refers to a digital camera. Would a 50mm lens on a digital camera give the same perspective as a 50mm lens on a 35mm film camera?*

The lens is the critical factor in taking the photograph. A 50mm lens on a 35mm camera would give the same perspective as a 50mm lens on a digital camera.

- *p. 24 – re photomontages –some views from non associated residences should be provided eg from houses to the south such as Mount Bathurst, Kringis Kalgoorlie Hall and Swatchfield – it is not just public viewpoints that matter;*

Additional photomontages are being prepared and will be forwarded when they are complete.

- *p. 43 – the Department has generally required landscaping within 4km, not 2km. Evergreen trees may not always be appropriate;*

As stated in the findings of the NSW Land and Environment Court ruling for the Taralga Wind Farm, the radius of landscaping is dependent on the circumstance of each location and a 2km radius was agreed as suitable by all three landscape experts and the Honourable CJ Preston in the judgement. Considering the topography within the viewshed around the wind farm site, additional landscaping is offered to residents only within a 2km radius. If evergreen trees are not suitable, deciduous trees would also be offered.

- *p. 43 – is a viewing area proposed?*

Yes – a viewing area with educational signage will be provided. The exact location is still to be determined, but most likely it will be located adjacent to the substation site.

- *p. 43 – it may be true that the overall benefits of the wind farm exceed the costs/impacts. However, some consideration should be given to those who might be impacted, and whether the impacts are acceptable – that is, are the visual impacts on individual properties within reasonable bounds? and given the EA claims the area has medium to high visual quality, how do the turbines fit into this?*

The impact on individual residences and the acceptability has been addressed above. The medium to high visual quality relates to the view shed of the wind farm. The visual quality is the result of extensive landscape modification associated with the establishment of agricultural practices since occupation of the region by Europeans. The landscape consists of large tracts of cleared land used for grazing or cropping and extensive areas of forestry that involves the rotational clearing of vegetation. Therefore, the visual quality of the area has a strong relationship to the modified landscape that incorporates working agricultural practices that continually alter the visual impact on the degree of naturalness of the area. The establishment of a wind farm is considered to be consistent with the existing impacts imposed on the naturalness of the amenity of the area by the current agricultural and forestry practices and therefore fits within the current practices that influence the visual quality of the area.

- *Appendix C (Shadow Flicker Study). Comments and questions include:*
    - *p. 5 – is it only within the house that matters – what about the immediate curtilage of the property?*

Shadow flicker only occurs on participating residences at certain times of the year in the early morning and late afternoon, when most people are inside their residences. There are no significant shadow flicker impacts on non participating residences. Therefore, the impact of shadow flicker is considered inconsequential.

- *Table 3.1 & Fig 3.1 – not entirely consistent. The Table shows House 35, which does not appear to be on the Figure. The Figure shows a House 67,which is not in the Table;*

- *p. 9 – states that shadow flicker impacts were carried out for 12 receptors, but 14 are shown in Table 4.1;*

- *p. 9 – the discussion about Table 4.1 is confusing – it states that only one property (house 28) could experience shadow flicker, but 3 are shown in the Table (none of which are house 28);*

A revised shadow flicker report has been provided incorporating the above comments.

- *p. 11 – indicates that House 27 is currently used as a shed. Could this change?*

No the shed is only intended for use with farm activities.

- *p. 11 – in terms of House 24, reference is made to the effect of screening, and the location of the main windows. However, the photo appears to show considerable gaps in the tree cover, and the curtilage would appear to be affected. More tree planting might help reduce shadow flicker, but would reduce views – is this acceptable to the residents? Are they an associated property?*

House 24 is the Acqualoria residence, they are a participating residence with the development. The proposed tree planting measures are suitable to the residents.

Noise Issues

- *as required in the DGRs, information should be provided on temperature inversions in this area, and the effect such could have on noise levels. Similarly, data should be provided on seasonal differences in noise propagation;*
-
- *p. 39 – reference is made to noise agreements. It is not clear whether these meet the SA guidelines i.e. whether the elevated noise levels will cause sleep disturbance, and whether the affected persons have been properly made aware of the potential affect on their amenity;*
-
- *p. 40 – refers to mitigation measures should noise levels exceed criteria. Measures that are applied at the receiver (eg double glazing) rather than at source will only be acceptable if the receiver agrees. Otherwise, criteria must be met;*
-
- *Appendix D (Noise Assessment) – there are a number of inconsistencies and apparent errors which must be addressed by the Proponent. Some of the issues include:*
    - *more information should be provided on the validity of the selected representative background noise monitoring locations;*
    - *p. 12 – why was the monitoring carried out in open farmland rather than at the house?*
    - *there is much confusion over the location and numbering of houses;*

  - *Figure 5-2 and associated text refer to the 3 representative houses as Baxter (house 63), House 24, and Miller (house 66). However, on figure 6-1, Baxter appears to be identified as house 33, Miller appears to be identified as house 25, while House 24 does not appear to shown at all – but another house in a different location is labelled 24;*
  -
  - *p. 15 and table 5-4. It is stated that 14 residences are affected by noise. However, House 24 (the representative one, not the one shown in figure 6-1) does not appear to be in this list – should it be? The table identifies a house 35 – this does not appear to be on figure 6-1. There are also a large number of houses shown on figure 6-1 which do not appear in the table. Presumably, they are considered to be not noise affected – can this be explained eg why is 67 excluded, but the more distant 23 included?*
  -
  - *p. 16 and table 6-1. The text states that 9 receivers are relevant. However, the table states there are 10 relevant receivers.*
  -
- *p. 40 – construction noise – are there any figures to substantiate the assertion that noise criteria will be achieved? Proposed construction hours should be stated;*

A revised Noise Study has been provided incorporating the above comments.

Flora and Fauna Issues

- *p. 48 – refers to minimal removal of trees – are there any native grasses?*

Native grasses such as *Poa sieberiana* var. *sieberiana* (Snow Grass), *Austrostipa sp. Eragostis* sp. and *Panicum simile* are present within the areas likely to be affected by the development. However, while these grasses may be present within affected areas, these areas are dominated by exotic grasses and weeds, resulting from the historical use of the area for grazing and agriculture. Such introduced species include *Cynosurus echinatus* (Rough Dog's Tail Grass), *Phalaris minor* (Lesser Canary Grass), *Cirsium vulgare* (Spear Thistle), *Urtica urens* (Small Nettle), *Trifolium repens* (Clover), *Echium vulgare* (Viper's Bugloss), *Taraxacum officinale* (Dandelion), *Marrubium vulgare* (Horehound), *Persicaria* sp. (Smart Weed), *Rubus fruticosus* agg. (Blackberry) and *Verbena bonariensis* (Purpletop). Such species are characteristic of weed infested pastures in grazing country west of the Great Dividing Range. As such, the proposal will be almost entirely limited to impacts upon disturbed exotic-dominated farmland / pasture habitats.

- *p. 48 – indicates that no further EPBC assessment/approvals etc will be required. However, the CVC Black Springs web site (Q&A) states that the proposal will be referred to the Department of the Environment and Water Resources (DEWR) under the EPBC Act. Has this happened?*

At the time of writing this response a referral had been submitted to the Department of the Environment and Water Resources for their consideration. This is more a result of taking a precautionary assessment approach, rather than referring due to the occurrence of matters of National Environmental Significance (NES). No NES matters were recorded as being relevant to the proposal or as being likely to be affected by the proposal.

- *p. 48/49 – reference is made to a monitoring programme re bird/bat strike. This is unlikely to be adequate. An adaptive management programme will also be required – to respond to the results of monitoring, if necessary;*

An Adaptive Management Programme will be enacted for the proposal. This will ensure that impacts upon birds and bats (and the environment in general) are monitored. Where issues are identified, appropriate responses will be implemented to ensure issues are addressed. Following approval of the wind farm, the adaptive management plan is likely to include measures such as:

- pre-determining mortality thresholds;
- identifying 'at risk' species for regular monitoring of movements and mortality;
- monitoring in accordance with AusWEA's standards and according to a standardised, repeatable methodology;
- developing a decision matrix that identifies how to respond to outcomes of monitoring results;
- where thresholds are exceeded responding by looking at turning off turbines at specific times, erecting diversion structures, enhancing off-site habitats and prey populations; and
- consideration of compensatory payments to local conservation initiatives or WIRES following mortality of significant species.

- *Appendix E (Flora and Fauna Assessment). Comments and questions include:*

    - *Table 4-1 indicates that there will be a medium – high risk of collision for a number of bird species. It is not clear how this relates to the text where risks are considered to be low, or to Table 6.1, where the risks seem to be lower than some of those shown in Table 4.1;*

As stated in the report, whilst risk potentials were classified into high / medium / low risks, it should be noted that the overall collision potentials of birds with the wind turbines is considered to remain relatively low. However, for discussion purposes it was necessary to determine which birds have a <u>relatively</u> greater risk of collision (despite the overall risk being low). It should also be noted that Table 4-1 is a relatively generic table that can be applied to provide an overall indication of the likely impacts of wind turbines on different Orders of birds and was included as a guide only. The more detailed and site-specific impact assessment information was provided in the mentioned text and Table 6.1 given other factors such as site-specific topography, likely flight patterns and observed flight behaviour. This site-specific assessment concluded that the overall risk to particularly threatened birds and bats was considered to be low for the proposal. It was also acknowledged that a low level of fatalities of common introduced and farmland native birds was possible, although this was not considered to be significant. In any case, this is not specifically required to be considered under the Threatened Species Conservation Act 1995 (or overriding EPA Act 1979).

    - *p. 34 – it is not true to say that Paling Yards and Taralga have been approved by DEWR;*

While technically it may not be true to say that these wind farms have been 'approved' by DEWR, both have been referred to DEWR, assessed, and determined not to be controlled actions. In effect this is an approval in relation to Commonwealth

NES matters in that DEWR has decided it does not need to be further part of the assessment process for these wind farms. In any case, this statement was made in relation to overall Swift Parrot assessment issues and not the Black Springs Wind Farm proposal specifically.

- *p. 35 – refers to avoidance behaviour as being a potential adverse impact on bats – but the issue does not appear to have been addressed;*

As stated in the report, there has been little study done on the actual impact of avoidance of turbines. Avoidance is more of an indirect impact, as it is unlikely to actually harm the bats (or birds), it is likely to be more of a 'nuisance'. This is particularly the case in relation to the Black Springs Wind Farm, which has a relatively small number of turbines that require avoidance. The energy expected to be required to avoid the nine turbines is not expected to be significant such that it would significantly impact upon the birds and bats recorded on the site. Likewise, the impact upon foraging habitat of these species is expected to be miniscule.

Avoidance impacts were assessed to some degree in the 7-part tests contained in the report. These included stating that the occurrence of the WTG's may result in the movement patterns of species changing in order to avoid blade strike. This change in behaviour is unlikely to substantially affect connectivity for species in the locality or region, as they are highly mobile. These species are highly sensitive to their environment and it is expected that such sensitivity will allow for these species to avoid the small number of WTG's proposed on the site. The habitat (airspace) to be modified can therefore be considered as not important to the long-term survival of the species in the locality.

- *pp. 36-37 & 39 -40 – reference is made to bird/bat strike monitoring, and to contingency plans/adaptive management programmes. However, there is little detail on what might be included in any such contingency plans i.e. how to deal with any problems that might emerge. Rather, the emphasis seems to be on data collection. Some details on response mechanisms should be provided. Perhaps more importantly, the EA itself and the Statement of Commitments (SoC) do not refer to contingency plans/response mechanisms – only to monitoring. There needs to be a commitment to respond to problems. The Proponent should note the adaptive management conditions that have been placed on other wind farm approvals to date. Also, the reference to monitoring for 5 years (p. 40) may not be adequate. The monitoring period will need to be developed in the adaptive management programme;*

Refer to previous response in relation to adaptive management plan approach.

- *p. 37 – any comment on horses?*

Horses are not expected to be an issue for the wind farm. Resident horses of the subject and surrounding properties are expected to be able to acclimatise and adapt to the turbines noise, shadow flicker and location. There is no indication in the international literature that wind farms have an adverse effect on horses.

- *p. 38 –more analysis should be provided on the effects of rocky habitat removal;*

Modification of a minor percentage of rocky habitat for the construction of the turbines and or cables and access roads is not considered to be a significant issue. There are no known records of any threatened reptiles or other terrestrial fauna that would be reliant upon such rocky habitat. Nonetheless as part of the preparation of Environmental Management Plan for the project it will be ensured that minimisation of impacts upon rocky habitat is identified as an objective. It should be noted that the rocky habitats that occur on the site in some cases are interspersed throughout cleared pasture. During construction it is anticipated that such rocky areas would be excluded from road construction and cables where possible.

<u>Heritage Issues</u>

- *Appendix F (Heritage Assessment). Comments and questions include:*
    - *p1&2 (section 1.3) – refers to the development footprint of the wind farm. There appear to be some inaccuracies in the assumptions made – it states the towers will be 110m high (EA states 124m), and indicates that overall construction will affect an area of 16m X 16m (EA figure 3.2 suggests that the turbine tower base could be 17m X 17m or bigger, the crane pad will be 35m X 18m or bigger, and the soft, levelled assembly area will be 35m X 30m or bigger). Do any of these differences affect the validity of the assessment?*

The differences stated in the Heritage Assessment are considered only minor and do not affect the validity of the assessment. The proposed sites and construction areas were inspected as part of the additional transects undertaken by Harper Somers O'Sullivan Archaeologist. The towers will be 80m tall, whilst the blades will be 44m long, (+ or – 5%), giving the structures an overall height of 124m. The exact turbine footing area will not be known until detailed geotechnical studies have been completed, however it is anticipated they will occupy an area of 16m x 16m. The temporary crane pad required for erection of the turbine is estimated at 35m x 18m whilst the turbine assembly area will require a level pad of 35m x 30m

- *p. 6 (section 5.2) – given the limited visibility, will further survey work be undertaken prior to any construction?*

Further archaeological survey work will be undertaken prior to construction. The proposed internal road and cable route and each site will be again inspected prior to construction. Further detailed road and cable design will be undertaken prior to commencement of construction. Turbine micrositing will also be undertaken subject to the completion of the detailed geotechnical assessment.

- *p. 6&7 (section 5.3) – refers to figures 5.3 & 5.4. Where are these figures? Are they figures 5.1 & 5.2?*

The reference to Figure 5.3 and 5.4 should have read "Refer to Table 5.1 Transect Notes – Surveys conducted by ERM 2005 and HSO 2006 and Table 5.2 – Effective Coverage – ERM 2005 and HSO 2006."

- *Table 5.1 – are the ERM transects (as shown in figure 5.1) for the area between turbine 02 and turbine 07/substation consistent with the turbine location and cable route now proposed (eg as shown in figure 5.2)?*

The transect between turbine 2 and 7 shown on the ERM transect in Figure 5.1 is consistent with the turbine and cable route now proposed. This route will be further inspected prior to construction.

- *Appendix A (ERM report) – the complete report does not appear to have been included – eg where is the 'strategic impact assessment and recommendation of mitigation measures' mentioned in 12.1.1 of the ERM report? It is also noted this is a draft report. Would a final report be likely to have changed significantly?*

The report is only in draft format as ERM did not finalise their report due to a change in consultancy services. ERM did agree to provide their report in draft format. To supplement the ERM report and provide a sufficient aboriginal heritage assessment, Harper Somers O'Sullivan were engaged to prepare a Supplementary Aboriginal Assessment. The Supplementary Assessment addresses the changes in the proposal from 33 to 9 turbines and provides final recommendations for the assessment. Therefore, it is considered that a complete Aboriginal Heritage assessment for the proposal has been undertaken.

Infrastructure and Utilities Issues

- *p. 53 and Appendix G. Section 5.8.2 refers to possible effects on one VHF signal – Burraga Fire Tower. It suggests that the effects are likely to be negligible, but mitigation will be provided if the wind farm is shown to cause a problem. Unlike other wind farm proposals, no mitigation is offered to deal with radio/television problems etc – why not? The Appendix:*
  - *suggests that the operator of the Fire tower link should be contacted for comment – has this occurred?*
  - *recognises that ghosting can occur with television, but states that 'although signal strength is not known it is not assumed that the wind farm will affect the TV signal from these towers as there are no significant built-up areas in the area serviced by these towers for which the wind farm could represent an obstacle' - what about effects on isolated dwellings? A precautionary approach, as taken with other wind farms, would be appropriate – i.e. commitment to fix any problems etc;*

If Burraga Fire Tower radio link experience radio interference as a result of the erection of the wind turbines, the proponent has stated that a radio receiver and transmitter repeater station will be installed on the turbine that interferes with the signal.

An On-site Signal Interference Study will be prepared relating to television and telecommunication signals pre and post construction. This study should allow quantitative analysis of the signal quality after installation with a comparison survey. The results of the On-site Signal Interference Study shall be provided to the Department of Planning. Remedial measures, if required, may include improved antennae, relocation of a transmitter, installing a repeater or cabling from a location clear of interference.

- *p. 54 – re aviation – any response from CASA re lighting? The EA mentions that there are two private landing strips in the area. However, their location is not identified, and no assessment is undertaken on any effect the turbines* *might have on local aviation. At p. 59 (section 5.8.6), the EA states air safety is an important factor associated with wind farms, and land owners with air strips within the vicinity of the WF should be notified prior to construction – this is inadequate. At least some assessment should be undertaken now to demonstrate there are no unreasonable impacts on aviation, including safety and use of aircraft (eg aerial spraying);*

A site inspection of the local landing strips revealed that two of the strips are no longer operational and are now covered by Forestry plantations. The Department of Planning have been advised during the exhibition period of a landing ground located on the Swatchfield property. From the advice received approximately 2-3 rotary wing movements are conducted at this site per week. No operative fixed wing airstrip is located on this property. It is understood that only a landing pad for the helicopter is present. No navigational aids for instrument approaches are located on the site, therefore there will be no impact on instruments flight to the landing area and the landing area requires a visual approach for all landings. Visual flight rules for helicopters determine a conventional circuit height of 800 feet AGL. Also, a helicopter undertaking low flying operations under Visual Flight Rule (CAR 157) must not fly lower than 500 feet above the highest point of the terrain and any object on it within a radius of 300m. This does not apply to helicopters arriving or departing a specified location. The distance between the closest turbine and the landing pad is approximately 1500m which provides able room for a helicopter circuit and landing at the Swatchfield property without any impacts from the wind farm.

In regards to aerial agricultural operations, it is considered that the turbines will not create safety hazards as the structures are clearly visible and pilots can easily avoid them. However, the turbines may restrict movements within some paddocks included in the project, these restrictions are considered to be minimised. This land is owned by project-related landowners who will be compensated by way of lease agreements entered into with the Proponent. No impacts from the turbines on non project associated properties for aerial agricultural operations are expected due to the distance between turbines and the layout of the wind farm. The lineal layout results in enough distance between the turbines to ensure that no restrictions exist for neighbouring properties. The proponent will also advise the Aerial Agricultural Association of the proposed development before construction commences. Additionally, the turbulence resulting from the operation of the turbines is not considered a hazard to aerial agricultural operations. The turbulence from each turbine is generally dissipated 3-4 rotor diameters downwind of the turbine. This distance is similar to minimum horizontal separation distance required for helicopters and is well below the 600m required for fixed wing aircraft. The undulating terrain of the site also prevents the sites use for emergency landings for fixed wing aircraft. Plenty of space exists between each turbine to provide a landing area for helicopters if an emergency landing is required.

- *p. 54/55 – re transport – there are no details here re volumes, need for road upgrades (weight, curves/alignments etc);*

The details regarding traffic volumes, weights etc is contained in Appendix D of the Transport Study.

- *Appendix A (Traffic and Transport Study). Comments and questions include:*
    - *the study is limited in its assessment of the adequacy of local roads to handle heavy and wide loads;*

It is considered that the local road network is suitable to provide appropriate access for heavy and or wide loads that may be associated with the construction of the wind farm. It is not considered necessary to upgrade any local road prior to construction. The proponent has proposed to undertake a photographic survey of the local roads before and after construction and will provide compensation to Council for any damage occurring as a direct result of the movements of over dimensioned loads and service crews during the construction period.

- *the study refers to a concrete batch plant operating on site (Daisybank), and that this will significantly reduce the distance concrete agitators need to travel, and thus reduce impacts (p. 15, Appendix A). However, the EA itself does not appear to mention that a batch plant is part of the proposal. The EA states at p. 8 that concrete agitators will deliver concrete to the site from Readymix at Oberon. This needs to be clarified. If a batch plant is proposed, then this needs to be stated and additional information provided about its impacts, including water sources. If not, then the Traffic Study needs to be updated;*

No batching plant is proposed for the site. The Transport Study has incorrectly stated that a batching plant will be located on site, however it has assessed the local road network with respect to the movements associated with the delivery of concrete to the site by concrete agitators. The Daily Axle Movements listed in Appendix D of the Transport Study lists 13,00 movements relating to the delivery of concrete from the local suppliers and the return trip to the batching facility.

<u>Bushfire Issues</u>

- *Appendix H (Bushfire Risk Management Plan). Comments and questions include:*
  - *is there a commitment to maintain water in the dams for bush fire fighting purposes? (the appendix says all measures should be taken to maintain such a water supply);*

No additional dams are proposed as part of the wind farm. Based on the experiences of the current drought it would be difficult to ensure that water is available at all times for bushfire fighting purposes. Several dams exist within the project area and these could be used for future fire suppression operations with the permission of the land owners.

- *will the presence of turbines have any affect on aerial fire fighting that might occur in the vicinity?*

The turbines will not impede on the ability of aerial fire fighting operations to be undertaken. The turbines would be turned off during a bushfire triggering an aerial fire fighting operation and sufficient distance exists between the turbines and any large contiguous forestry plantation or native vegetation to allow aerial fire fighting operations. The turbines are large structures with adequate spacing to allow aerial movements between each turbine. As most aerial fire fighting is undertaken using rotary wing aircraft, the ability to move between turbines exists. Additionally, the turbine layout is predominately linear and parallel to the small adjacent segment of the Vulcan Forest that is located along the western boundary of the Daisybank property. Should fixed wing aircraft be used, a unobstructed aerial water bombing path could be used parallel to the turbine layout for this compartment of the Vulcan

Forest. The wind farm would also provide a good reference point for aerial operations during periods of aerial fire fighting.

Socio-Economic Issues

- *p. 63 – socio-economic – how relevant is a study for a different proposal?*

The study is relevant as the current proposal is a revised version of the original 33 turbine proposal. The current site is part of the original larger site. The community was informed about the project and community information provided. The current project is not a completely different project but a downscaling of the original proposal, therefore all information and consultation undertaken at the start of the process is still relevant. This study has been strengthened by further additional community consultation. An addendum to the study has been prepared that outlines the community consultation process since lodgement of the Environmental Assessment. A copy of the Addendum is provided with this response.

- *p. 64 – re community polarisation – some idea of the actual scale of the proposed 'community investment opportunities' would be useful i.e. how much is being offered, who decides etc*

This is answered in more detail below.

- *Appendix I (Socio-Economic Impact Report). Comments and questions include:*
    - *the socio economic appendix is very limited in its assessment. Basically, it refers to property values (dealt with in more detail elsewhere); visual impacts (dealt with in more detail elsewhere); and community identity/cohesion;*
    - *the report suggests the Proponent should pursue education and 'community investment opportunities', but makes no commitment nor suggests anything specific. More should be provided on these potential community benefits;*
    - *some information should also be provided on jobs, multiplier effects etc i.e. the benefits that will accrue to the local community from the direct investment in constructing and running a wind farm. There is some very general reference to these matters in the EA, but no attempt to quantify any of these benefits;*

There are a number of potential socio-economic benefits that could result from the development of the wind farm. The construction of the wind farm will require labour and resources that could be provided from the Oberon and Black Springs area. Additionally, the potential for increased tourism opportunities also adds significant potential for further spending in the local community. These activities inturn inject new investment dollars into the area, where a percentage is spent by the recipient. The re-spending of additional investment dollars in the area results in multiplier effects which ensure that the benefits are spread through the community. The indirect investment in local companies through construction and on-going tourism potential will contribute to the development of employment through the local area. Attached is a table demonstrating how tourism contributes to the economic benefit of an area through economic multiplier effects.

To further quantify some of the benefits, the following analysis methodology from Magill and Watt (2003) has been used to calculate employment and financial indicators for the Black Springs Wind Farm. The relative costs for the development of the wind farm can be broken down into approximately 50% for the turbine, rotor and associated components, 15% for the tower, with e remaining 35% attributed to site preparation, installation and project development. With a focus on local sourcing where possible it is estimated that the project will achieve an Australian capital cost value of around 44-50%, equivalent to (Aus) $14.3M – $16.3M. Estimating how much of this capital investment will be spent in the Oberon region is difficult, though much of the preparation and construction will be sourced from local businesses.

To estimate the number of direct jobs years associated with the construction and ongoing operation and maintenance of the wind farm, estimates have been derived from AusWEA (2005). AusWEA undertook an analysis of actual jobs resulting from existing Australian wind energy projects. The analysis removed two projects where local manufacture of the wind turbines attributed to a much higher proportion of jobs and averaged the results. Excluding the two projects, the average construction job creation per MW of installed capacity averages 0.75 job years. The total generation capacity proposed for Black Springs Wind Farm is 18.9MW which is equivalent to 14.2 job years, with the majority of this figure expected to be regionally distributed. The ongoing operation and maintenance is estimated to employ 2-3 jobs directly (Passey 2003). Attached is copy of the Passey Report (2003) that reviewed investment and job generation associated with Wind Energy in Australia. The Passey Report further qualifies the estimated investment and job generation associated with the Black Springs proposal.

To assist in achieving community cohesion, WCA will establish a community development fund generated from the revenue received by the wind farm operation. The amount of funding has not yet been finalised. The fund will provide a source of funding for community related projects. The purpose of the fund is to provide the local community with a direct economic benefit from the operation of the wind farm and foster a relationship of goodwill between the developer and the community. It is hoped that the establishment of the fund and the direct benefits for the Black Springs community will help to mitigate any perceived community polarisation by bringing the community together through positive outcomes for the town. The monetary contribution for the fund will be announced at a later stage.

<u>Cumulative Issues</u>

- *p. 67/68 – cumulative – generally this section does not really address the additional impacts that the proposal might have on top of existing impacts.*

The additional impacts that the development of the wind farm may have on the Black Springs area relate to the short term impacts associated with construction activities and the long term impacts that predominately relate to visual, flora and fauna, noise, heritage, socio-economic and infrastructure. The short term impacts of construction activities have been assessed, with the main cumulative impact relating to transport matters and potential conflicts with the existing forestry logging haulage operations. This matter has been addressed in the Traffic and Transport Study with suitable mitigation measures outlined to minimise any potential impacts on road users and conflict with haulage contractors.

The long term cumulative impacts of noise will be restricted to the immediate area of the wind farm as modelled and therefore this is considered acceptable. Flora and fauna cumulative issues relate to the potential for bird and bat strike, which has been addressed in the Ecological Assessment are considered as acceptable. The cumulative impacts associated with heritage are minor considering the findings of the heritage assessment and are therefore considered acceptable. The cumulative infrastructure impacts relate to additional potential for aviation hazards, though this has been assessed by Air Services Australia, who have indicated that the Lowest Safe Altitude for aviation operations for the area will be revised to account for the wind farm. Mitigation measures relating to television and communication cumulative impacts will most likely improve these services if they are required. Consequently, infrastructure cumulative impacts are considered acceptable.

The socio-economic cumulative impacts of another infrastructure project in the area have already resulted in some polarisation of the community. However, the development of the wind farm will contribute socio-economic benefits both directly and indirectly to the region. The construction period will utilise local resources and labour, and the ongoing operations will attract tourists, all of which will have flow on economic multiplier effects. The establishment of a development for the local community will provide direct community benefit by contributing funding for community projects. It is felt that the socio-economic benefits that will be derived from the proposal will assist in mitigating any perceived polarisation of the community once the local community start to experience these benefits.

The most predominate cumulative impact is related to the visual impact; however, the visual impact; is restricted to the localised area around the wind farm. The majority of the residents in Black Springs will not be able to see the wind farm from their homes. The addition of the turbines will result in a visual cumulative impact, though the location of the wind farm is visually isolated from populated areas. While the location of the wind farm is only three kilometres away from Black Springs village, the visual impact is restricted to only a small number of residences due to the topography. The visual impact on these residences as stated previously is considered acceptable.

The potential locations for a wind farm are limited to a suitable wind resource. The Australian Wind Atlas identifies only a few locations in NSW with suitable winds for a wind farm to commercially operate. Within these areas it is difficult to locate a position that has minimal impacts on the flora and fauna, surrounding residences and has suitable access to the electricity grid. Black Springs Wind Farm is considered as an ideal location because of the ability to comply with these factors. Therefore, due to the location and minimal impacts on existing residences, plus the benefits the wind farm will contribute in providing clean, renewable energy for the good of the wider community, the cumulative impacts are considered acceptable.

<u>Chapter 6</u>

- *p. 72/73 – DPI (minerals) comments – need to clarify current status of these comments;*

On the 8th May 2007, representatives for WCA met with Straits Resources in Perth to discuss the concerns Straits Resources holds with respect to the wind farm development. All of the issues listed by Straits were worked through. Straits Resources and the proponent agreed to resolve any perceived potential development conflicts and have drawn up a Term Sheet that will form the basis for a Memorandum of Understanding between the two companies. The terms of reference outlines the agreed measures that will allow both companies to actively pursue their development interests. Once the respective boards from both parties approve the Term Sheet this will be provided to the Department of Planning and also to DPI.

- *p. 74 – Country Energy – any response re connection issues?*

A connection application has been lodged with Country Energy for the proposal. The proponent is currently negotiating the details of the connection agreement with Country Energy. No connection constraints exist for the wind farm, which would prevent the wind farm to connect into the 66kV line that runs through the site.

- *p. 74 – CASA – any response?*

CASA indicated that prior to CASA commenting on the proposal, the project would have to be assessed by Air Services Australia. Air Services Australia have finalised their assessment and have indicated that the Lowest Safe Altitude (LSALT) for the area would need to be raised because Turbine 6 impeded the LSALT and that the LSALT would need to be raised by 100 feet to 5500 feet. The process to raise the LSALT takes six months and WCA are to advise Air Services Australia of a construction date following an approval of the project.

CASA have now been forwarded this information and are currently preparing their response. The CASA response will be forwarded once it is received.

<u>Chapter 7</u>

- *p. 76 – 80 – Environmental Risk Analysis – the methodology seems to be unsubstantiated. At best, the individual scores are a highly subjective, broad scale, qualitative ranking of specific impacts. It is not clear how this ranking was done – by one person? did it include community values etc? At best, it might give a feel for the direction of impact. To then add the individual numbers and come up with a score (+7) is of limited value. Even if there were some validity to the individual scores, they would at least have to be weighted before anything meaningful could be said. The inclusion of decommissioning is questionable, given much of it relates to 'fixing problems' the proposal has caused, and that the 'benefits' are distant. Some other specific issues:*
    - *p. 76 – reference to Table 6 – should this be 10?*

Yes, reference to Table 6 should be Table 10.

  - *p. 78 – Table 12 refers to Table 12 – presumably the latter should be 11?*

Yes, the reference should read Table 11.

  - *p. 79 – some of the rankings are questionable;*

How the rankings were determined is outlined below. The questioning of the rankings only further highlights the subjective nature associated with different people's attitudes to different matters.

  - *p. 79/80 states that nearly all impacts can be reduced to acceptable levels, except for local visual impacts. Reference is then made to screening residents within 2km (note the Department generally recommends 4km), as offsetting visual impacts, but Table 13 claims to have included mitigation measures (which presumably would have included screening at residences) – and come up with an 'unsuitable risk level'. So, does this mean that visual impacts are unacceptable?*

The purpose of the Environmental Risk Analysis is to determine the following questions:

- What might happen?
- How might it happen?
- Will it be serious if it happens?
- What is the likelihood of it happening? and;
- What is the risk?

The first two questions are scoped out through the various environmental studies undertaken for the proposal. These are listed in the individual reports contained in the Appendices of the Environmental Assessment. A summary of the issues and how they result is outlined in Section 5 of the report. To determine the severity of each issue a scaling checklist was employed. This method allowed a subjective decision to be quantified into a severity rating that could assist in determining what the final risk associated with that issue might be. The severity of each issue identified is listed in the Environmental Impact Summary at the end of each sub section of Section 5. The ranking for each issue was determined then evaluated by the planner for the project based on the results of each environmental study and was then confirmed by the relevant authors of those studies as acceptable.

Community values were not incorporated into the assessment as this would result in an even more subjective evaluation to an already qualitative issue. Therefore, it was determined that the relevant expert opinion of each consultant was sufficient to provide a balanced assessment of severity and likelihood for each issue. It was necessary to quantify the severity of the issues to determine the final risk. The severity of the impact is required along with the likelihood of the impact occurring, to determine how much risk that impact poses. The methodology for this approach was derived from Thomas (2001) and is considered a fair and acceptable methodology for assessing the risk of the environmental issues associated with the project. Table 13 Environmental Risk Assessment for BSWF provides the assessment of each risk associated with the project. No weighting is required for the scores attributed to each impact listed in Table 13 as these provide an individual answer to the potential risk associated with each impact. Each of the impacts is considered acceptable. The severity of the visual impact is considered marginal and the likelihood of the event is considered 'likely'. This equates to a risk score of 4, equivalent to a moderate risk. A moderate level of risk, while not ideal is acceptable and highlights the need to ensure that visual mitigation measures are implemented. As stated previously the visual impact is considered as acceptable.

<u>Chapter 8</u>

- *p. 81- 91 – Statement of commitments – a few comments:*
    - *p. 83 (item 2) – is a linear layout really better?*

The linear layout (7 turbines in a line running south-north) reduces the visual impact on the closest residences located to the south of the project. If it was not linear, these residences would view more of the turbines. The linear layout therefore minimises their cone of view.

- - *p. 84 (item 5) – double glazing is only relevant if owners agree – otherwise, the project must comply with criteria;*

The noise modelling demonstrates that the wind farm will comply with the SA guidelines. Offering further mitigation measures to reduce impacts is an acceptable approach to further mitigate noise concerns of non participating residences.

- *p. 84 (item 5) – it is not just a question of complying with SA criteria. There should be a commitment to comply with the predicted maximums, providing they are within the SA criteria. That is, if the modelling shows that the turbines can perform better than the SA criteria, then they should do so – this is consistent with the DEC's approach and the Minister's other approvals;*

This is the approach that will be adopted with this project also.

- *p. 86 (item 9) – more than monitoring for bird and bat strike is required – i.e. adaptive management;*

As stated previously, an adaptive management program will be implemented.

- *p. 88 (item 13) – need commitment to television reception;*

A commitment to mitigating any adverse television reception impacts will be complied with.

- *p. 88 (item 14) – if there are any impacts on local aircraft operations, there may need to be some other commitments eg additional costs of fertiliser or herbicide applications;*

It is considered that there will be no impact on local aircraft operations.

- *p. 89 (item 21) – any committed value?*

A value of this commitment has not been finalised.

- *p. 90 (item 22) – how is this a mitigation measure?*

Active support in further researching this controversial issue will assist in determining if land values decrease (not evident from recent sales in Black Springs). This information could then be disseminated back to the community to provide feedback to any concerned landholders.

- *p. 93/94 – CEMP – this is more expansive than the CEMP described in section 2.6. However, missing issues include – bushfire, flora and fauna, and cultural heritage. It is not clear why operational waste management is included in the CEMP. It is also not clear why there is a combined noise and air strategy – nor what air emission and control measures refers to, and note that dust management is separate from the air strategy;*
- *p. 94 – EMP – shouldn't this be OEMP?*

These issues have been addressed previously in the responses provided.

Chapter 9

- *p. 95-97 – project justification – the DPI/mineral resources issues needs to be resolved; the main aim of the CEMP is not to address occupational health and safety issues – it is about environmental management; scale of socio-economic benefits should be stated.*

These issues have been addressed previously in the responses provided.

References

AusWEA (2005) *Wind Energy Jobs* available at: http://www.auswea.com.au/auswea/downloads/wind_energy_jobs_2005.pdf

Passey R (2003) *Driving Investment, Generating Jobs: Wind Energy as a Powerhouse for rural & Regional Development in Australia*. Available at: http://www.auswea.com.au/auswea/downloads/passeyjobsreport2032003.pdf

Attachments

Addendum to Community Consultation Report

Additional photomontages

Aerial photo of Swatchfield Landing Ground

Cone of View from Southern Residences

Department of Lands Works Approval

Energy Calculation Report

Passey Report

Shadow Flicker Report

Statement of Commitments Report

Substation Layout Plan

Addendum to Black Springs Community Consultation Report

Report Prepared by: Angus Holcombe
Report Date: Tuesday, 22 May 2007
Report Status: FINAL

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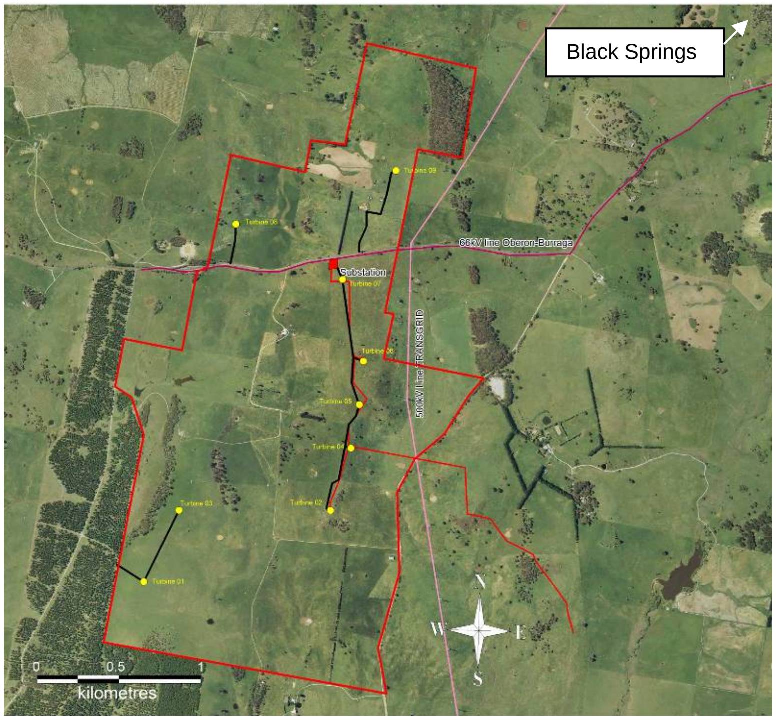
Executive Summary



The Black Springs Wind Farm proposal is based on the installation and operation of 9 Suzlon S88 Wind Turbine Generators or equivalent to be connected via underground cables across two privately held landowner's residences. The hub height of the turbines will be 80 meters and the rotor diameter will be between 80 metes and 88 meters. The turbines will have a generating capacity of 2,100 kilowatts each.

The wind farm will have a generating capacity of 47,000,000kWh, equivalent to the annual requirements of 6,000 NSW households, which will avoid the production of up to 43,660 tonnes of greenhouse gases. The installation of the Black Springs Wind Farm has the potential to promote Oberon Shire as a producer and user of renewable energy throughout Australia whilst having a potentially positive effect on the local tourism industry.

The scenic quality of the area will be impacted by the turbines, though the perception of the impact will vary according to each individual's perception of wind farms and their attitude towards renewable energy production. The turbines have been located so as to comply with all relevant standards and guidelines as well as to provide a balance between the community needs and perceptions, the environmental issues, energy output and the need to reduce the impact on climate change.

The noise study was completed by Energreen Wind using the industry best practice Windfarmer™ software. The noise study adheres to the strict South Australian Environmental Protection Agency (SAEPA) and NSW Industrial Noise Policy Guidelines and is considered as conservative with real noise levels likely to be below the levels calculated.

The Black Springs Wind Farm will also provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings. The project will assist the region to meet environmental objectives and the principles of Ecologically Sustainable Development through the generation of renewable energy, and consequent greenhouse gas abatement. The proposed wind farm does not involve the removal of native vegetation or trees and is compatible with the agricultural activities currently undertaken on the land. No significant flora and fauna impacts will result from the development of the wind farm.

The proposed Black Springs Wind Farm Project will be connected to the 66kV Country Energy operated Burraga – Oberon transmission line (currently operated at 33kV). Initial discussions with Country Energy have indicated that the line is likely to be able to take the energy generated by the project. The advantage of such a connection would be increased quality of supply to Burraga and Oberon due to reduced transmission losses and the use of a sustainable and environmentally friendly electricity supply.

Wind Corporation Australia is confident that this project is not only complying with the relevant standards and guidelines but also provides significant benefits to the region such as:

- Reduce greenhouse gas emissions and help fighting the effects of Climate Change;
- Provide emission free reliable energy to the local consumers and industries in Oberon Shire;
- Improve the quality of supply in the Black Springs/Burraga area;
- Provide another potential tourist attraction;
- Provide additional jobs in the Shire during construction and operation;
- Provide business opportunities for local contractors and businesses;
- Help local farmers to generate additional income allowing them to continue their traditional business.

Designed to have minimal environmental impact we consider this project as a positive addition to the diversity of Oberon Shire.

<u>Community Consultation Report – 1st March 2007</u>

On Thursday 1st March a Community Consultation day was held to inform residents of the progress of the proposed Black Springs Wind Farm toward its development goals. The consultation was conducted in the Black Springs Community Hall between 9am and 5pm. Mark Foggarty, (Director – Wind Corporation Australia) and Angus Holcombe (Project manager – Energreen Wind) were present to answer questions and provide information on the project.

Approximately 45 people attended the consultation with various forms of opinion expressed. Visitors were invited to complete a survey form during the consultation with a total of 28 people agreeing to do so. Of these recipients;

2 were neutral
6 were supportive of the project, and
20 were opposed to the project

Concerns outlined by those opposed to the project included, but were not limited to;

- Devaluation of land values for residents surrounding and within 10km of the project

- Increased noise levels at surrounding residences and on proposed properties adjacent to the site
- The project was inefficient and would not produce the estimated power
- Damage to roads during construction

Those in favour of the project were so for the following reasons;

- Increased economical activity for Black Springs and surrounding areas
- Reduction in dependence on fossil fuels
- Improved and varied source of electricity generation
- Identified Black Springs as a town actively addressing climatic variations recently exacerbated by drought

There were a remaining 12 to 15 attendees who advised of their support for the project however declined to complete a survey form, in some cases due to the presence of a very vocal and parochial “No Campaigner”.

At times, members of the “No Campaign” were hostile and argumentative toward those present who were in favour of the project.

Specifically “No Campaigners” stated their intention to “frustrate legal contracts between the developer and landowners” and signalled their intentions to issue claims for damages against both landowners involved in the project.

Information was also obtained which identifies the current noise levels experienced by Oberon Shire following the construction of the Timber Factory at Oberon. This has been attached to this report for viewing also.

Community Consultation Report – 19th May 2007

On Saturday the 19th May 2007 an additional Community Consultation day was held at the Black Springs Town Hall from 9am to 2pm. It was originally planned to conclude the day at 5pm however due to only 8 people attending the consultation it was decided to conclude the day early. Contact details for Angus Holcombe, consultant to Wind Corporation Australia, were left at the Hall for those who arrived after 2pm.

Name	Previously Attended Consultation	For/Neutral/Against	Comments
Graham & Lindal Precians	Yes	Against	Properties devalued
Andrew & Tony Morrison	No	Neutral	Asked for completed photomontages
John and Margaret Slotjke	Yes	For	Renewables are the way of the future
Leo & Doreen Grady	Yes	Against	Properties devalued

Table 1: Community Consultation Summary

This additional consultation phase was conducted due to concern by some members of the Black Springs Community that the previous session held on Friday 1st March was insufficient as some members would be unable to attend during office hours. Based on the limited attendance however it would appear that very few members of the community remain unaware of the project or feel that they require any further information regarding the proposal. This limited attendance may also be attributed to personal consultations conducted by Angus Holcombe on Thursday and Friday preceding the Saturday consultation.

Prior to the consultation Angus Holcombe, as a member of Energreen Wind, consultant to Wind Corporation Australia, visited as many of those members of the community opposed and in favour of the project as he could on Thursday 17th and Friday 18th May to discuss the proposal and the concerns and ideas those residents have, based on the proposal and wind energy in Australia.

A number of people were contacted prior to Thursday 17th May to make an appointment to discuss the project however many residents declined to meet with Wind Corporation consultants.

Concerns Raised

A number of concerns and issues were consistently raised throughout discussions held on Thursday and Friday. These included but were not limited to;

- The efficiency of wind generation as compared to existing generation techniques
- The decrease in property values which could be expected following the installation of the wind farm
- That the turbines would consume electricity from the grid when the wind is not blowing. (This does not happen)
- The project receives significant State and Federal Government subsidies.
- That the project will not reduce Australia's Greenhouse Gas emissions significantly and therefore should not be allowed to proceed
- Many in favour or not opposed to the project have expressed their disgust at the treatment and accusations directed at the landowners involved in the project.
- Those residents in favour of the project proceeding have reiterated the point that many others in favour of the project are quietly supportive of the proposal.

Further Consultation

There is considerable scope for further consultation to occur with the Black Springs community. As part of Wind Corporation Australia's formal response to submissions made under the Part 3a process more photomontages will be prepared to allow for a more rigid assessment of the proposal. In conjunction with this further consultation will occur with the residents of Black Springs, prior to the response being finalised to the Department of Planning.

Consultants to Wind Corporation, Energreen Wind have also made it clear to the residents that any further requests for information or personal consultations would be accommodated and made available at the earliest possible convenience for both parties.

<u>Appendix 1</u>

Thursday 10th May 2007

- Rang Frank & Eileen Hanrahan inviting them to discuss issues they have with the project on Friday 18th May. No answer.
- Rang Glen & Lisa Behan inviting them to discuss any issues they have with the project on Friday 18th May. No answer.
- Rang Graham & Lindal Precians inviting them to discuss concerns regarding the project on Friday 18th May. No answer.
- Spoke with Graham Gilmour and booked in 9am Friday 18th May. Main concerns included;
    - Subsidies from the Howard Government
    - There are better suited areas
    - Community is being divided
    - Value of nearby 40 – 50 acre blocks is being driven down
    - Area is highly populated
    - "Daisybank" owner bought into the area and hasn't lived there all his life
    - Similar to the transmission line where owner of "Swatchfield" took TransGrid to court and got compensation for those affected landowners
        - Graham lives at "Branxton Park" 3km down Tilsbury Lane.
- Spoke with Bob Packer, retiree, born in Sydney. Main concerns;
    - Wind Corp had to "buy out" Winton Park.
    - Longer construction period than has been stated in Environmental Assessment
- Spoke with Doreen Grady and left a message for Leo to call and arrange time to meet on Friday 18th May.

Friday 11th May 2007

- Frank & Eileen Hanrahan not home.
- Graham & Lindal Precians not home.
- Spoke with Peter Dove, President of the Progress Society and confirmed that the Hall would be available for Saturday 19th May.

Monday 14th May 2007

- Spoke with Chris Baker, John Baxter's solicitor at Storey and Gough to obtain John Baxter's telephone number.
- Left a message with Ralph Tambasco to meet on Thursday. He was unable to meet due to prior commitments.
- Spoke with John Slotjke, who has written a letter of support for the project in the Oberon Review. He was unable to meet on Friday or Saturday 19th May.
- Spoke with Leo Grady at 5:30pm. He will attend the Community Consultation on Saturday but unavailable to meet at all on Friday 18th May.
- Graham & Lindal Precians declined to meet with me on Friday however will be attending the Community Consultation on Saturday 19th May. Glen & Lisa Behan met with me on Thursday 17th May at 4pm.
- Spoke with John Baxter at 6:20pm. He declined to meet with me on Friday prior to the Consultation day and also denied access to his property "Swatchfield" to allow any further photomontages to be taken from his property. He was explicit in his instruction that under no circumstances were we to enter his property to complete any further photomontages.

Tuesday 15th May 2007

- Rang Cathy Grear. 6 Reserve Avenue, Black Springs. Left a message inviting her to take up the offer to meet with me on Friday 17th May.
- Spoke with Kevin Hillsden. He is a good friend of Dave Kennedy's and was originally involved with the project. He is of the opinion the project will be on-sold by Wind Corporation Australia once approved. He would like to see other sites considered.
- Left a message with Dave Black, of Dog Rocks Road, inviting him to visit the community consultation on Saturday 19th May.
- Rang John and Beverley Maclaren who were not home. 6:12pm
- Rang Austen Knight who was not home. 6:15pm
- Spoke with Malcolm Rich who claims the industry is heavily subsidised. He said he would attend the Community Consultation day however did not arrive prior to 2pm. He also declined a visit from me on Friday 18th May.
- A. Still was not home. 6:25pm
- Bruce Grey did not leave a phone number to be contacted on.
- Spoke with Suzzanah from the Oberon Council;
  - Informed me that Oberon Dam level is currently at 17%
  - Was going to attend the Community Consultation however did not arrive prior to 2pm

Thursday 17th May 2007

- Travelled to Black Springs and spoke with Glen and Lisa Behan. Took Glen for a drive to show him where the turbines would go and how many he would see from his house. Concerns included;
  - How many turbines would be visible from there property
  - Whether noise would be a problem for there house.
  - What would happen if there television reception was affected
  - Would a mobile phone tower be installed if the project were granted planning approval
  - As a rural contractor could Glen get a job on the wind farm
  - Will the strobing affect be a concern for there family

Friday 18th May 2007

- Graham Gilmour 9am to 11:30am. Concerns included;
  - The project would require more back-up generation from coal fired power plants
  - Believes turbines are inefficient
  - Is concerned that a "super annuation" company is situated to take over the project as soon as its constructed or even approved
  - Is well aware of the mining lease over Black Springs and surrounding areas.
  - Graham and John are both meeting soon with Frank Sartor to outline the following arguments;
    - The Gibbs enquiry found that TransGrid had treated the community poorly in situating a power line across the Black Springs district and Wind Corporation is acting in a similar manner.
    - Also claims that the community was not adequately consulted prior to the lodgement of the DA.

    - Concerned the project will not reduce greenhouse gases by the amount stated in the Environmental Assessment
    - Would prefer the project at the top of Abercrombie Road to proceed
    - Believes that many of the issues which we attribute to global warming may simply be part of a larger cycle.
    - Does not see any scope for the project to proceed even if benefits were to flow to the wider community.
    - Sees the project as a political stunt rather than a genuine effort to reduce carbon emissions.
- Met with Carmel in town to pick up the key to the Black Springs Community Hall.
    - Indicated that the way landowners involved in the project had been treated by the people of Black Springs was wrong and had driven many people who were originally against the project to be in favour of the project
- Peter Dove – President of the “Progress Society”
    - Peter is against the project based on the visual appearance of the turbines despite the fact he will be unable to see them from his property.
    - Peter explained the “Progress Society” is unwilling to take a position on the project as it aims to remain a-political!
    - Peter is happy for the logging to continue and the forestry industry to continue however is not keen to see the wind farm proceed as it will be a constant activity in the landscape.
    - He believes the area to be pristine and does not want to see further development within the area.
    - Would rather take the risk with coal rather than using wind power.
    - Peter was unaware of any project here when he arrived in the area.
- Mark – Lives opposite Frank Hanrahan (Abercrombie Road)
    - Happy to see the development proceed in its current form. Will not be able to see any of the turbines from his property.
- Frank Hanrahan – 2pm
    - Frank is against the project however was not aware of the number of turbines involved in the project and will not be able to see any of the turbines from his property.
    - Frank was interested to learn about the efficiency of the turbines, where the electricity would go from the project, how cost competitive wind energy was, how a project like Black Springs would become viable, why the REC price had fallen so dramatically in the past 4 years and what would happen to the turbines at the end of the 25 year lifetime.
    - Frank remains opposed to the project based purely on the inefficiency of the turbines and the visual appearance of the turbines.
- Went looking for Anne Kringas, “Kalgoorlie Hall”. She is not home and not answering her phone. Unable to gain access for visual montage.
- Visited number 32 Campbell’s River Road. Not home.
- Visited 12 Campbell’s River Road (Paul Arico). Not home and gate padlocked. Unable to ask to complete a Photomontage as required by the Department of Planning.
- Visited 861 to 869 Campbell’s River Road subdivision.
    - Spoke with Peter Cook. He has agreed for us to complete a photomontage from his property.
    - Spoke with Bruce Grey who is also happy for us to complete some photomontages from his property.

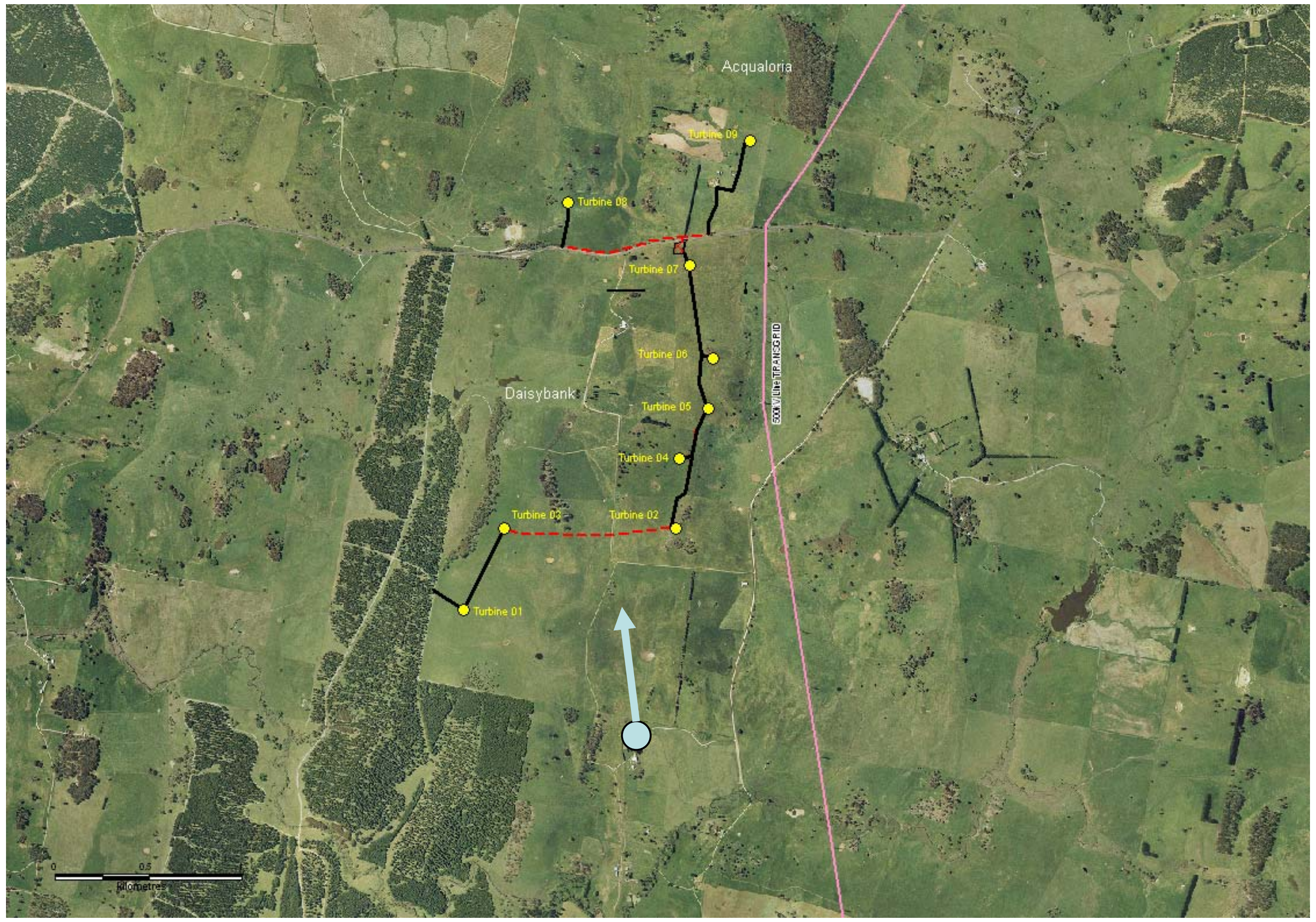
- Visited Anne Kringas' property again to see if she had arrived.
- Spoke with John Baxter 5:20pm to see if he would agree with a photomontage being taken from his property. John agreed once told that DoP had specifically requested it.

Saturday 19th May 2007

- 9:37am. Spoke to Lindal and Graham Precians. Lindal is the secretary of the Black Springs Landscape Guardians.
    - Opposed to the project based on the devaluation of properties in the Black Springs district.
    - The Landscape Guardians firmly believe the project will be afforded State and federal Government subsidies.
    - Stated that the wind resource was marginal at best and that without State Government subsidies would not be a viable project.
- 10:56am. Spoke with Andrew and Tony Morrison from 937 Campbell's River Road.
    - They would like a copy of the photomontage completed from the subdivision on Campbell's River Road, once complete.
    - They are as yet undecided about whether or not they are in favour of the project proceeding
    - They would like to see a mobile phone tower installed.
- 11:30am. Spoke with Leo and Doreen Grady. They are opposed to the project as they feel it will devalue their property and those around the district.
    - They are not interested in any of the potential benefits which may flow to Black Springs and the surrounding districts.
- John Slotjke and his wife also attended the Community Consultation and again offered his support for the project.

Original Photo

Photomontage



Direction on Map shown in true north

Photo Point:	01 - Kringas
Position (UTM WGS84 Zone 55):	750185E / 6247162N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	50mm
Date:	07-06-2007
Time:	2:25pm
Height above ground level:	1.7m
Elevation a.s.l.	1,114m
Direction (deg mag.):	~310°
Nearest Turbine (m):	1,146m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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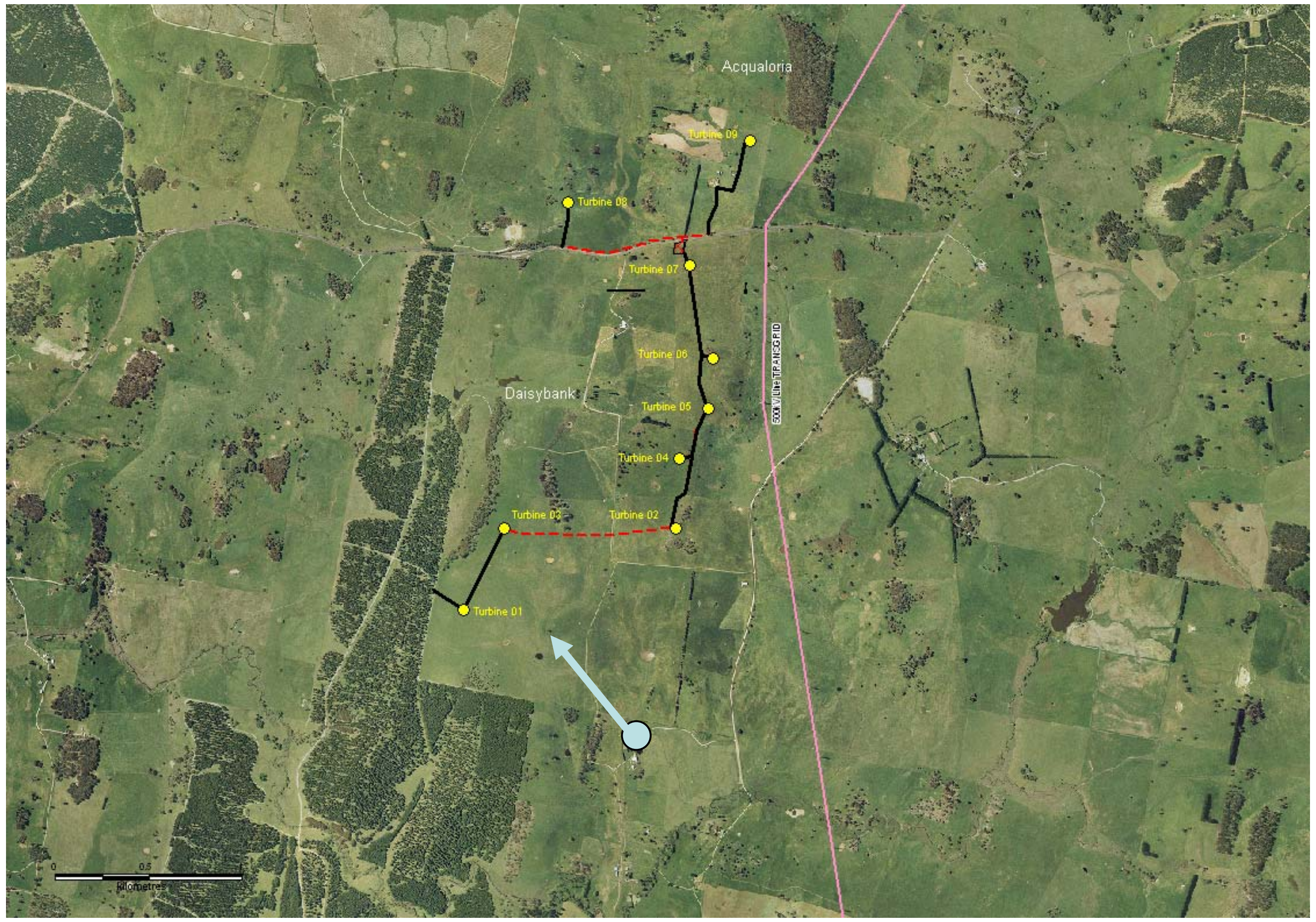
Original Photo

Photomontage



Direction on Map shown in true north

Photo Point:	02 - Kringas
Position (UTM WGS84 Zone 55):	750185E / 6247162N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	50mm
Date:	07-06-2007
Time:	2:30pm
Height above ground level:	1.7m
Elevation a.s.l.:	1,114m
Direction (deg mag.):	~305°
Nearest Turbine (m):	1,146m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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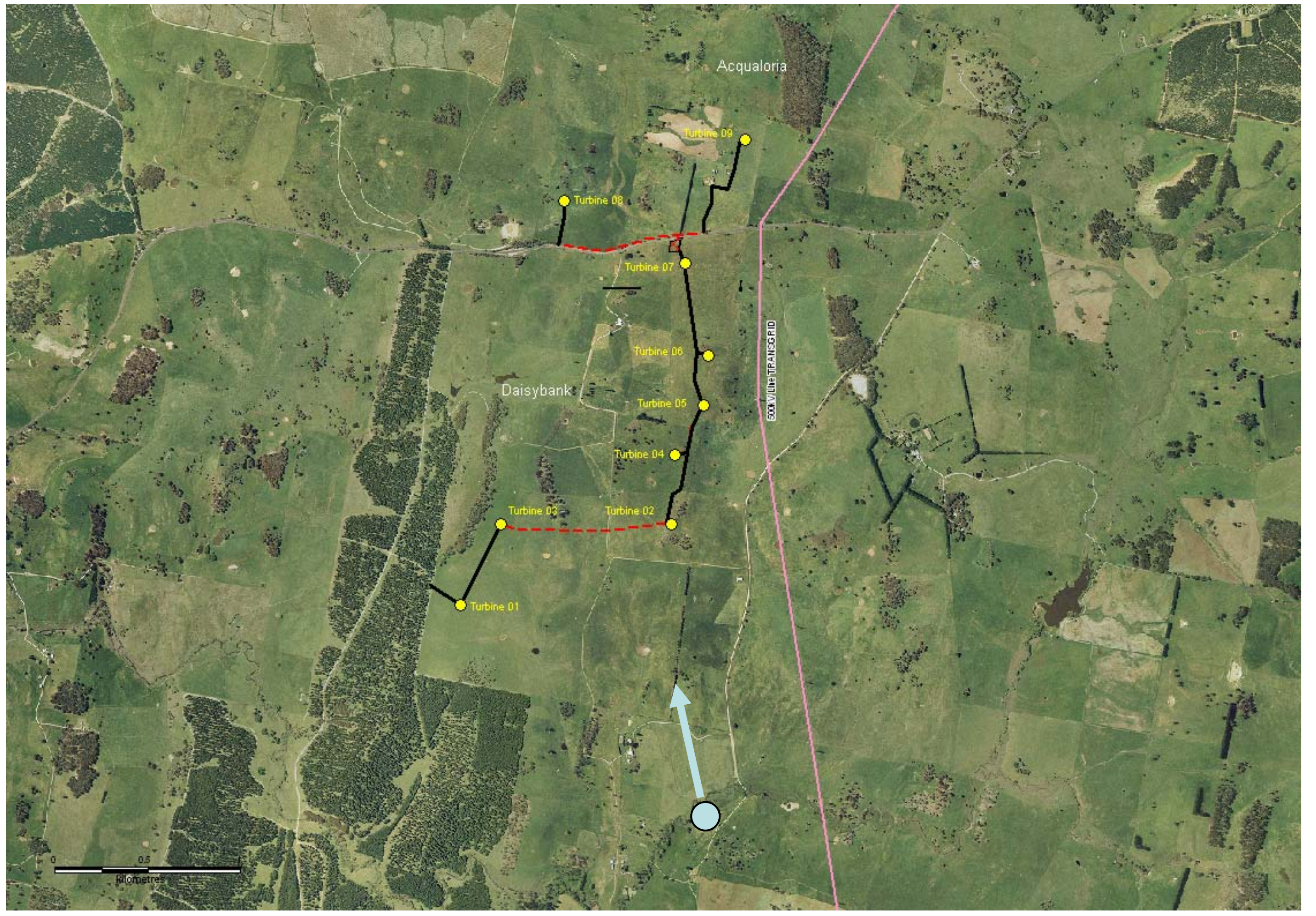
Photomontage



Direction on Map shown in true north

Photo Point:	03 - Baxter
Position (UTM WGS84 Zone 55):	750645E / 6246689N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	38mm
Date:	07-06-2007
Time:	2:40pm
Height above ground level:	1.7m
Elevation a.s.l.	1,103m
Direction (deg mag.):	~310°
Nearest Turbine (m):	1,632m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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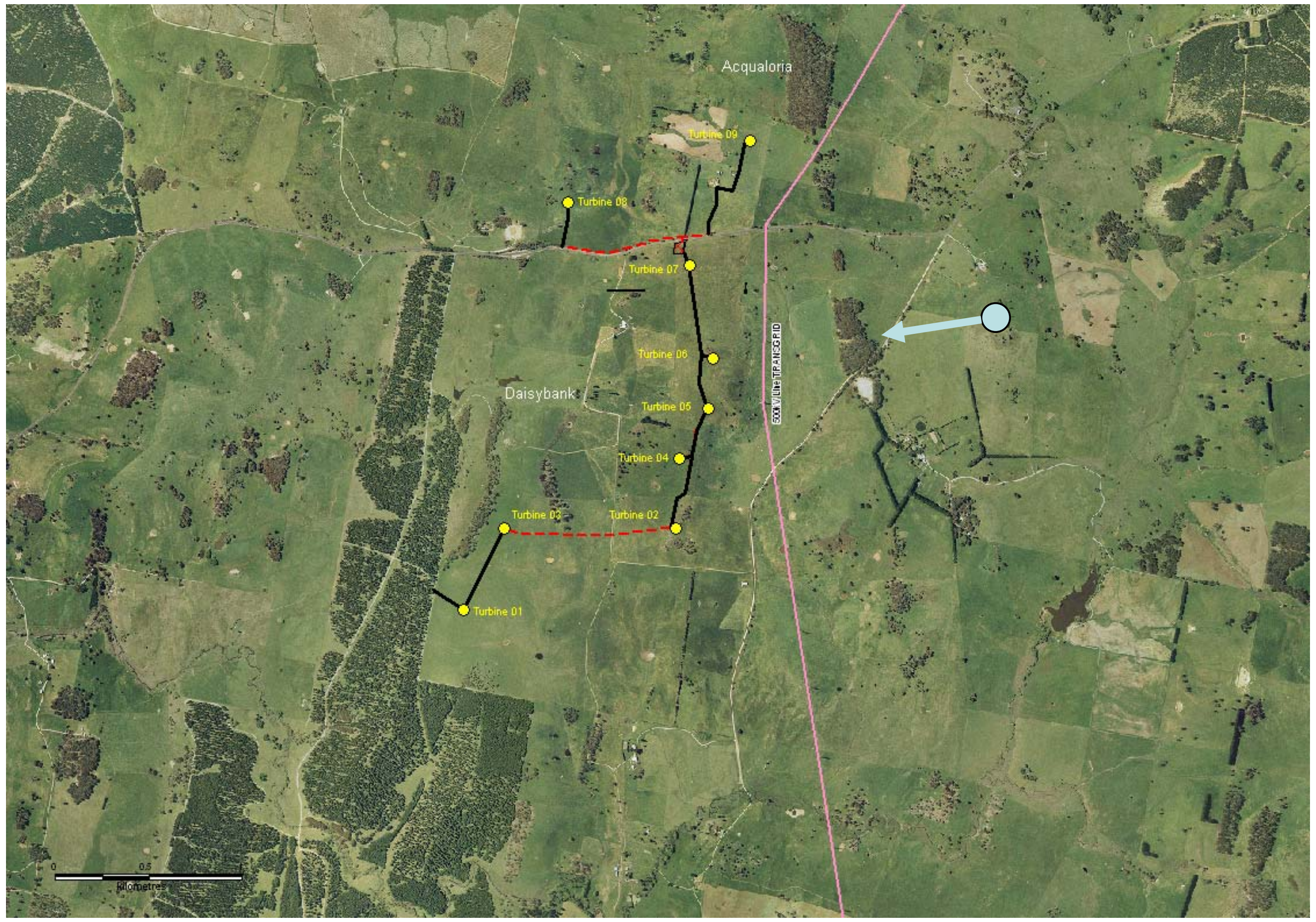

Direction on Map shown in true north

Photo Point:	04 - Gribble
Position (UTM WGS84 Zone 55):	752087E / 6249434N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	34mm
Date:	07-06-2007
Time:	2:55pm
Height above ground level:	1.7m
Elevation a.s.l.:	1,227m
Direction (deg mag.):	~245°
Nearest Turbine (m):	1,476m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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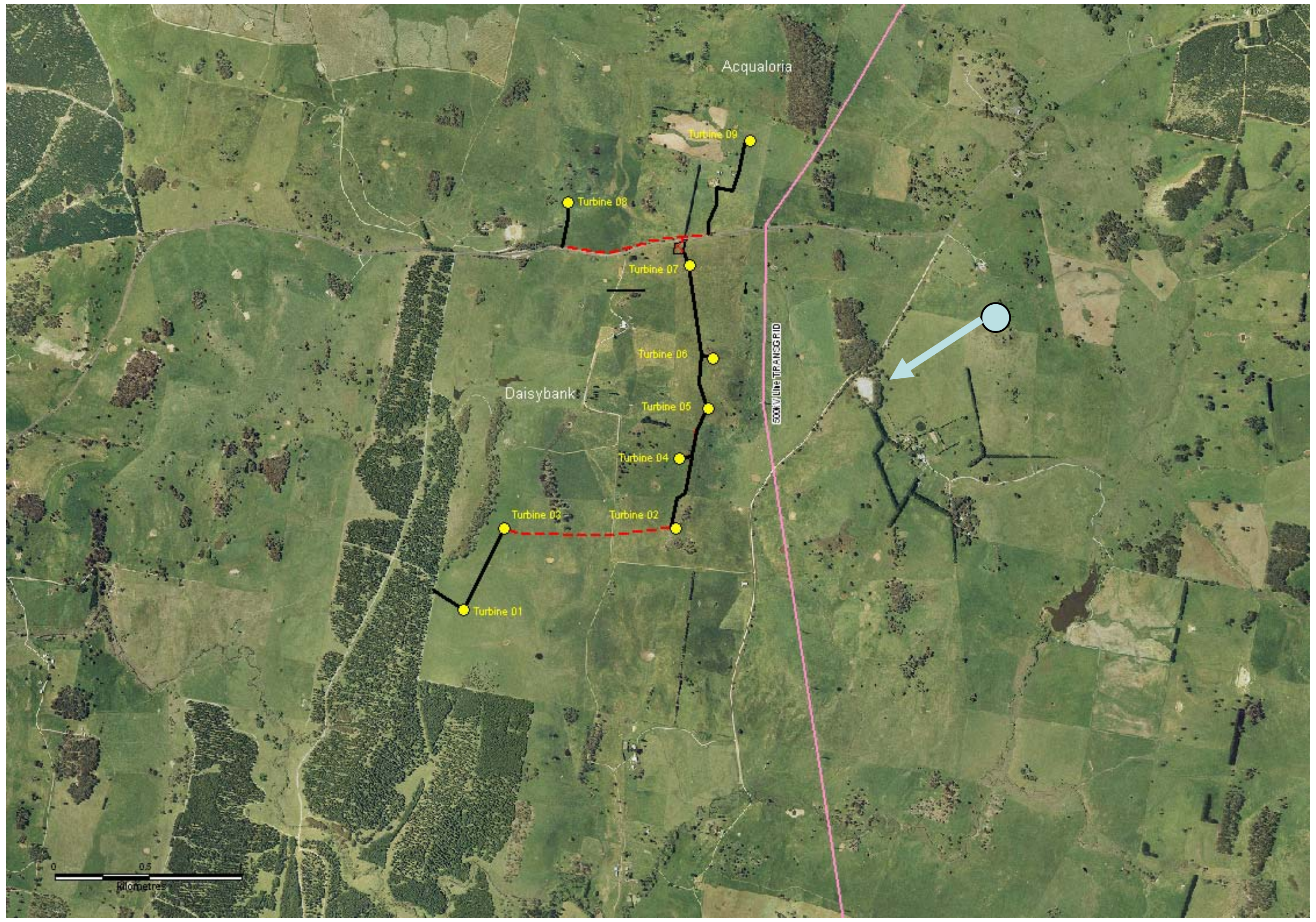
Photomontage



Direction on Map shown in true north

Photo Point:	05 - Gribble
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Lens:	34mm
Date:	07-06-2007
Time:	2:55pm
Height above ground level:	1.7m
Elevation a.s.l.:	1,227m
Direction (deg mag.):	~220°
Nearest Turbine (m):	1,476m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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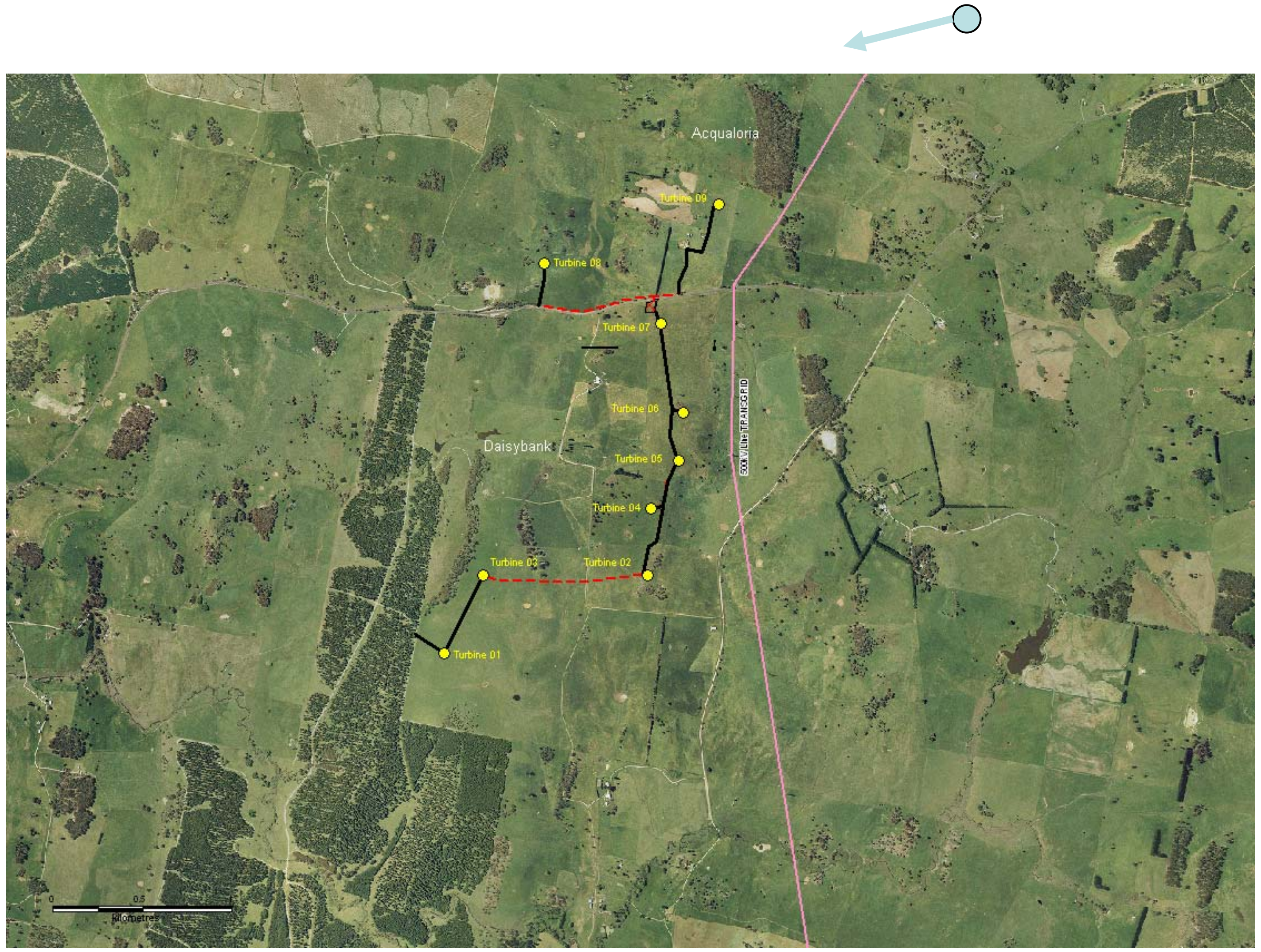
Original Photo

Photomontage



Direction on Map shown in true north

Photo Point:	06 - Arico
Position (UTM WGS84 Zone 55):	753587E / 6251217N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	34mm
Date:	07-06-2007
Time:	3:15pm
Height above ground level:	1.7m
Elevation a.s.l.:	1,201m
Direction (deg mag.):	~240°
Nearest Turbine (m):	2,879m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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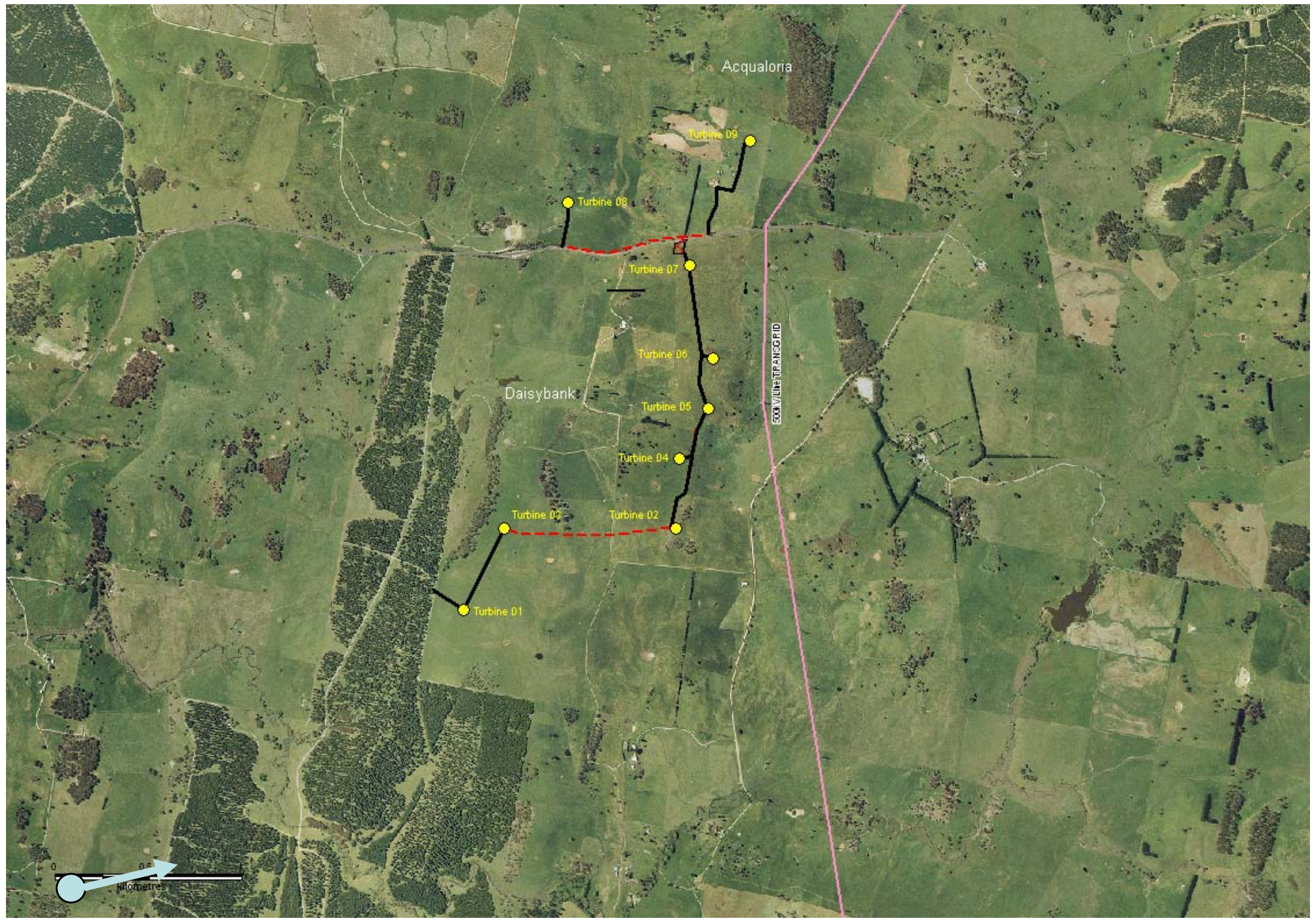
Original Photo

Photomontage



Direction on Map shown in true north

Photo Point:	07 - Jackson
Position (UTM WGS84 Zone 55):	747127E / 6246329N
Camera:	Canon EOS 300D (Digital SLR)
Lens:	42mm
Date:	07-06-2007
Time:	3:40pm
Height above ground level:	1.7m
Elevation a.s.l.:	1,084m
Direction (deg mag.):	~60°
Nearest Turbine (m):	2,650m

Photomontages based on 20m contour lines.
Software used for Photomontages: Windfarmer™

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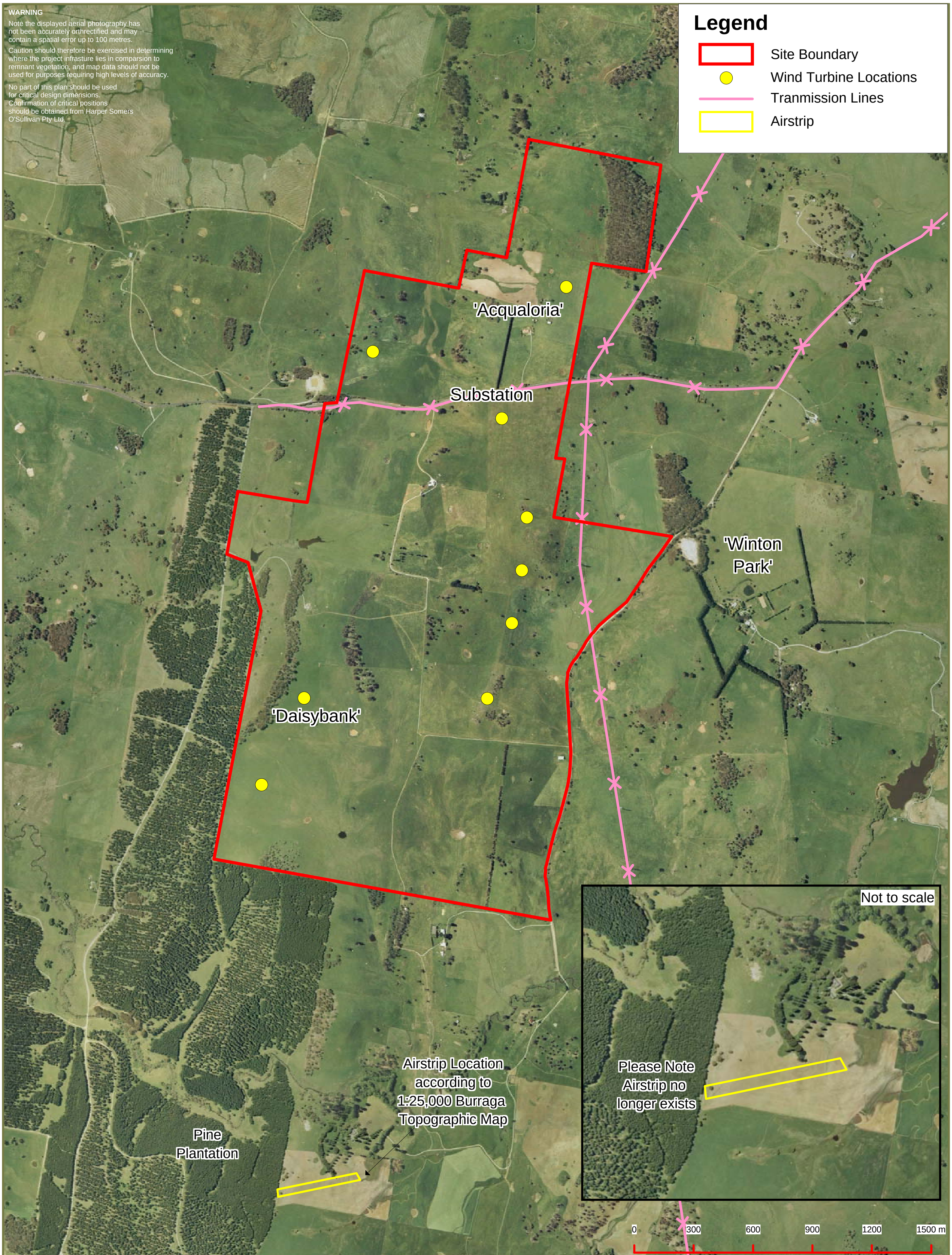

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AMENDMENT	DATE	TYPE
A		
B		
C		
D		

SCALE: 1: 25000 at A4 Size
DATE: 7/6/2007
DATUM: AMG Zone 55 (AGD 66)
CONTOUR INTERVAL: N/A
DESIGNED: D. Landenberger
APPROVED: M. Doherty

AIRSTRIP LOCATION
BLACK SPRINGS WIND FARM, OBERON LGA

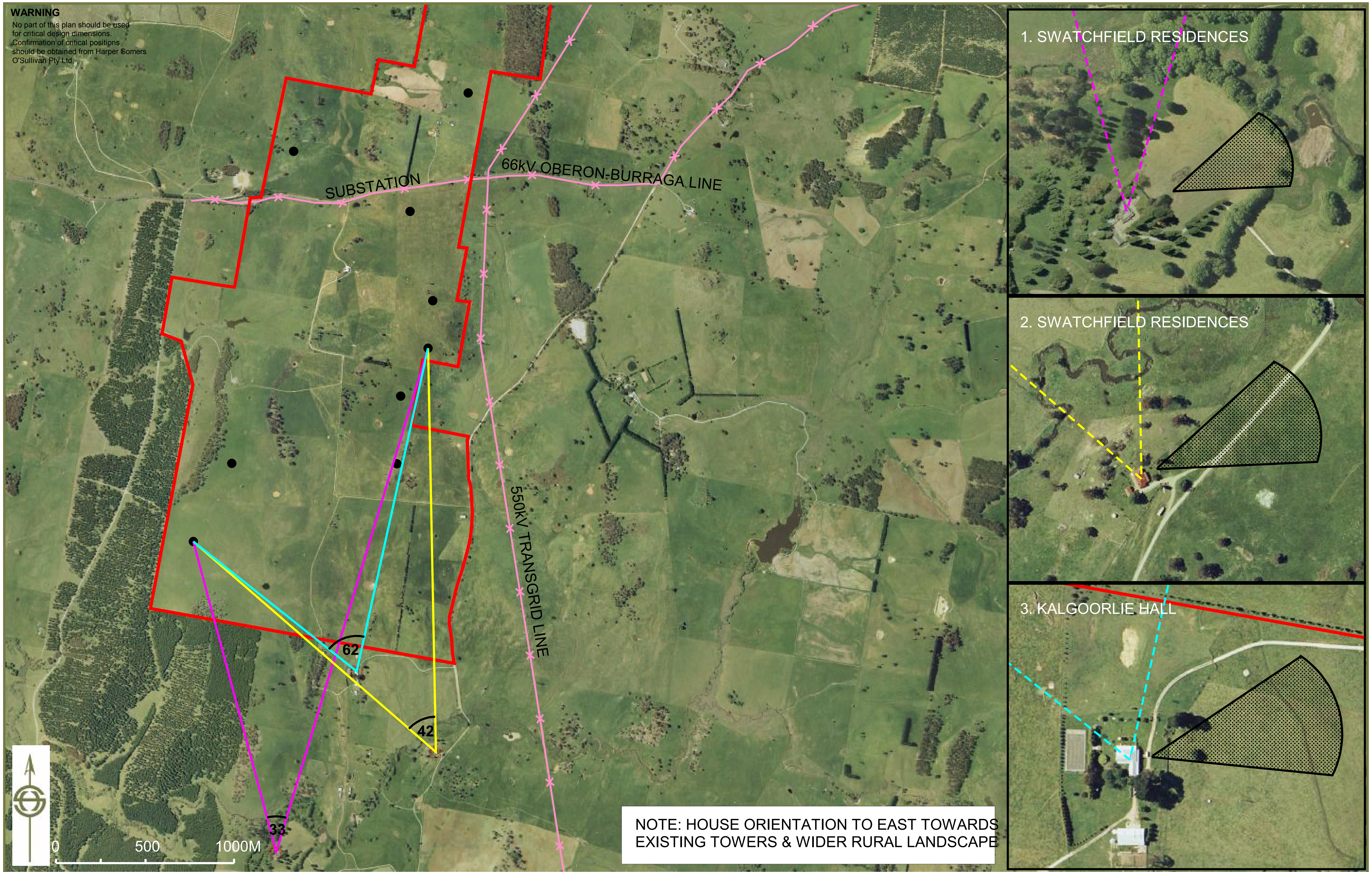
Allco Wind Energy Management

LAYOUT REF: J:\JOBS\23k\23219 - Black Springs\Drafting\Mapinfo\Planning\23219 AIRSTRIP LOCATION A-A4

JOB REF: 23219

PLANNING SURVEYING ECOLOGY

E: survey@hso.com.au W: www.hso.com.au



TITLE:

CONE OF VISUAL INFLUENCE

BLACK SPRINGS WIND FARM, OBERON NSW

CLIENT:

ALLCO WIND ENERGY PYT LTD

PLANNING SURVEYING ECOLOGY

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T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

SCALE:	1: 20000 at A3 Size	**DRAWN:**	M DOHERTY
APPROVED:	S MCCALL	**DATUM:**	AMG Zone 55 (AGD 66)
DATE:	31/5/2007	**LAYOUT REF:**	J:\JOBS\23k\23219 - Black Springs\Dra .... Mapinfo\Planning\23219-CONE OF VIEW-A-A3.WOR
CONTOUR INTERVAL:	N/A	**JOB REF:**	23219

Department of Lands
Reliable from the ground up

Steven McCall
Harper Somers O'Sullivan
Via email
steve@hso.com.au

Tel. 6391 4309, Fax. 6362 3896
tamsin.martin@lands.nsw.gov.au
www.lands.nsw.gov.au

30th May 2007

REF: Black Springs Wind Farm Development Proposal

Dear Steven,

As per our discussions yesterday, I am writing to give you approval to undertake temporary works on an unformed Crown road within the lots described within the development application.

The works will require a trench to be dug across the Crown road easement (typically 20.115m). This approval is subject to the following conditions:

1. The road surface will be remediated to the existing condition of surrounding land;
2. Appropriate erosion and sediment controls will be in place during construction to prevent any sedimentation either on the Crown road or on adjoining land;
3. The remediated surface will not prevent access along the Crown road corridor as required under the NSW Roads Act; and
4. No trees or large shrubs will be removed.

If you have any further questions, please contact me on the numbers above.

Yours sincerely,

Tamsin Martin
Team Leader - Environment
Land Management, Crown Lands

New South Wales Government

Black Springs Wind Farm

Energy Calculation

Document Status: FINAL-REV C
Date: 18-June-2007

Author: ______________________
Bernhard Voll

Energergreen Wind Pty. Ltd. ABN 900 9946 0518
57 Carlotta Street
Greenwich, NSW 2065
Tel: 02 9438 3725 Fax: 02 9439 8657

1 Spatial Wind Speed Distribution

The wind speed distribution (at hub height) across the site is shown in Figure 1-1. This wind climate has been calculated using the state-of-the-art wind analysis software WAsP[1] which is used by many wind farm developers, government institutions and universities to analyse wind data measured by wind monitoring towers and calculate wind speeds for larger areas.

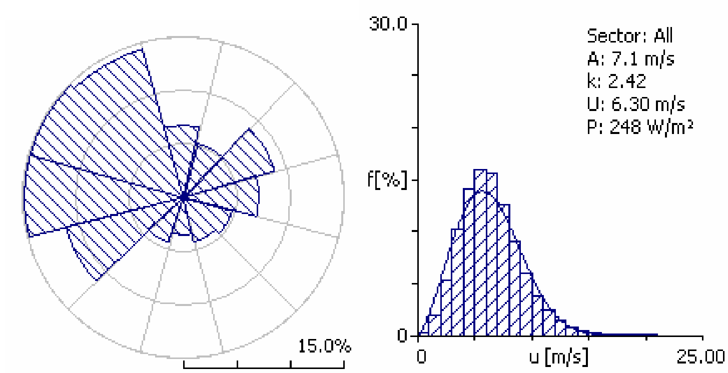

Figure 1-1: Wind Climate at Wind Monitoring Tower[2] (note: wind speed at measurement height)

The data calculated by WasP was then loaded into the Windfarmer™ software, anotrher state-of-the-art software program to analyse wind farms and optimise energy production with respect to a large number of parameters. This software has been developed by Garrad Hassan, a leading consultant in this field. Figure 1-2 shows the wind speed map from the Windfarmer™ software.

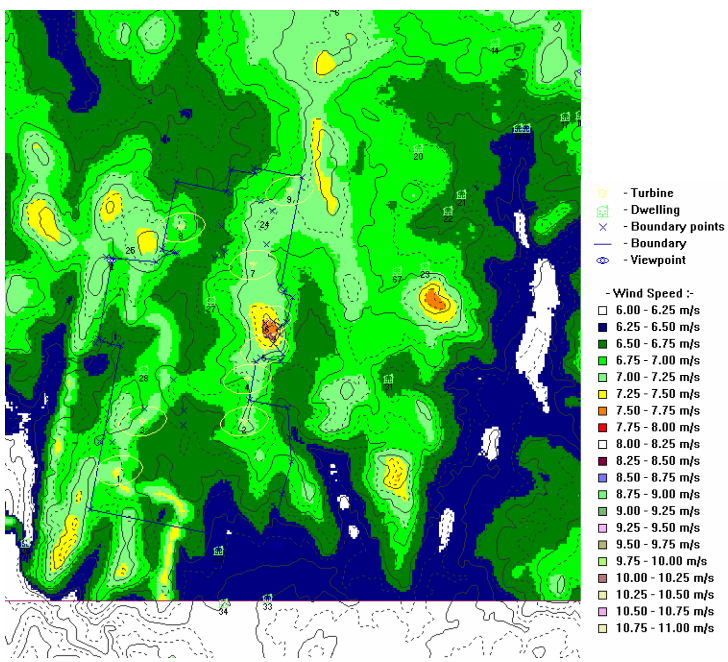

Figure 1-2: Wind Speed Map

[1] WasP = Wind Atlas Analysis and Application Program
[2] U = average wind speed in m/s, A = Weibull scale parameter in m/s, k = Weibull shape parameter, P = Wind Energy Content

2 Calculation principle

In principle all energy calculations for wind farms calculate the energy produced by a wind turbine using the wind speed distribution curve and the power curve for the individual turbine. Figure 2-1 shows the power curve for the Suzlon S88 turbine and Figure 2-2 shows the wind speed distribution.

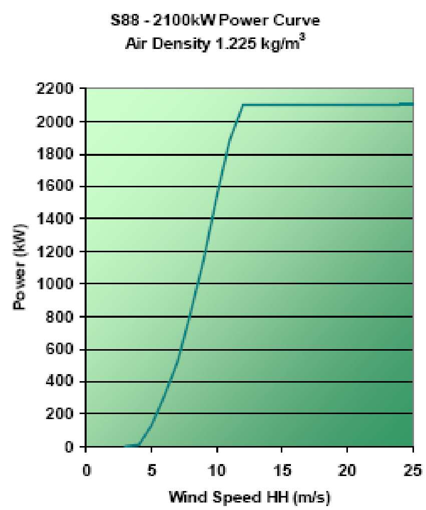

Figure 2-1: Suzlon S88 Power Curve

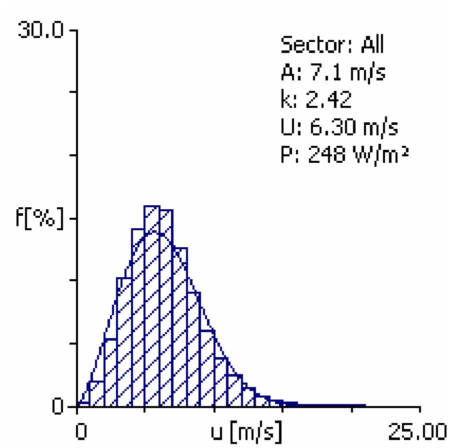

Figure 2-2: Wind Climate at Black Springs (note: wind speed at measurement height)

To arrive at the annual energy generation the percentage of a specific wind speed is used and multiplied with the power generation of the individual turbine at this specific wind speed.

Example:

- 10m/s wind speed occurs at 8.1% of time
- Wind Turbine generates 1,540kW at 10m/s

- Energy generated for 10m/s:
  E_{10} = 8.1% * 1,540kWw * 8,760h = 1,092,722.4 kWh = 1.093 GWh

This calculation is done by the Windfarmer™ software individually for all wind directions and wind speed sectors across the wind farm taking into account topographic effects, losses caused by turbulence and other turbines, electrical losses and turbine availability.

3 Energy Calculation

Once the turbines were correctly positioned and optimised with respect to noise, shadow flicker and visual impact the potential energy output of the wind farm was calculated taking into account the topography, air density, turbulences caused by any obstacles on site and the wake effect which represents the turbulences caused by turbines when the wind passes the rotor. The results of this analysis are shown below.

Ideal energy production	**52.9**	**GWh/yr**
Topographic efficiency	97	%
Array efficiency	96.1	%
Electrical efficiency	97	%
Availability	97	%
Estimated annual net energy production	**46.42**	**GWh/yr**[3]
Estimated capacity factor	28	%

The capacity factor shows the average output of the wind farm over the year compared to it's rated capacity. The calculation is shown below:

Estimated annual net energy production:	E_{net} = 46.42 GWh
Rated annual energy production	E_{max} = 18.9MW * 8,760h = 165,564 MWh = 165.56 GWh
Capacity Factor	C = E_{net} / E_{max} = 46.42/165.56 = 0.28 = 28%

The sophisticated WindFarmer™ software is able to calculate the capacity factor using the wind speed measurements taken over the last two years at the site and combining these measurements with the turbine locations.

[3] Estimated generation slightly lower than predicted due to change of location for turbine 04

energreen wind

Black Springs Wind Farm

Noise Study

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Table of Contents

Figures and Tables

1 Introduction

The Black Springs wind farm is located approximately 25 km south of Oberon in NSW. The project will consist of 9 wind turbine generators with a hub height of approximately 80m and rotor diameter between 82m-88m. For the purpose of this study the analysis is based on an indicative turbine layout consisting of 9, Suzlon S88 turbines (hub height 80m, rotor diameter 88m).

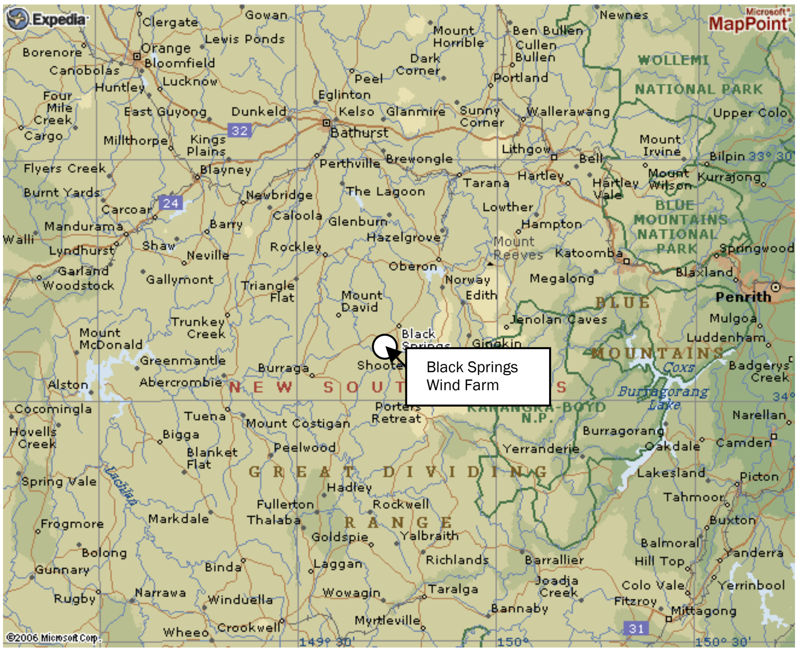


Figure 1-1: Overview Map

The guidelines followed in this report are the South Australian Environmental Protection Agency (SA EPA) Environmental Noise Guideline: Wind Farms (SA EPA Guidelines)[1]. This standard provides guidance in monitoring, predicting, and assessing noise from wind farm developments. It sets a noise limit for residences and sensitive locations that are not financially involved in the project of the greater of 35 dB(A) or 5 dB(A) above background noise. Note that the Director General's Requirements for the EIS also request this study to be performed in accordance with the NSW Industrial Noise Policy, however this Policy states that it is not applicable to wind farms, hence it is not relevant to this study. The SA EPA Guidelines have been adopted by the NSW Government as assessment guidelines for wind farm noise.

The "Daisybank" (House No. 28) and the "Aqualoria" Residence (House No. 24) are involved in the proposed development and are hence considered as "non-relevant residences" since there is scope in the SA EPA Guidelines for agreements regarding the noise level at such residences to be made between the developer and the landowner as long as the maximum noise levels in such agreements are still considered reasonable. The "Miller" (House No. 25) residence (owned by Forestry Commission) is also considered as non-relevant as the owner has indicated that higher noise limits will be accepted.

Comparison of the predicted noise output, measured background noise, assumed background noise and the SA EPA noise limit were carried out over a range of wind speeds and locations. The noise level generated by the wind farm is within the limits set by the SA EPA Guidelines, the NSW

1 Wind Farms: Environmental Noise Guidelines, Environmental Protection Authority of South Australia, February 2003

Industrial Noise Policy and other standards such as the NZ Noise Standard[2]. The wind farm therefore complies with the noise limits set by the NSW Government.

The results of these comparisons, of the background noise measurements and the noise level prediction are presented in this report. The noise model used for the wind farm noise prediction is based on ISO 9613-2[3] and classified as simple noise model using no specific ground attenuation and a fixed reference frequency of 500 Hz. This model is more conservative than more complex sound models and therefore represents a worst case scenario.

2 NZ6808:1998 – Acoustics – The Assessment and Measurement of sound from Wind Turbine Generators, Standards New Zealand

3 International Standard ISO 9613 " Acoustics – Attenuation of sound during propagation outdoors"

1.1 Nomenclature

The following terms are used in this report:

Sound Power Level	the source sound emission level in dB(A)
dB (decibel)	the units of sound pressure level or sound power level (logarithmic scale)
dB(A)	'A' frequency weighted unit of sound pressure level. The A level approximates the sound perception of the human ear
L_{Aeq}	the average sound level over the measurement period
L_{A90}	the sound level that is exceeded 90% of the time for a given period
Hz	Hertz – unit for frequency
AGL or agl	above ground level
a.s.l	above sea level
m/s	meters/second

2 Wind Turbine Noise

The most noticeable sound produced by a wind turbine can be described as the periodic "swish-swish" of the blades cutting through the air. Although the blades continuously create this noise while rotating there is a pressure change as the blade passes the tower and an intermittent "swish-swish" sound is propagated.

This sound is not mechanical and does not generally have a tonal nature but is rather a "white[4]" noise and therefore decays more rapidly with distance.

The noise output of a turbine increases with wind speed however the background sound pressure level, which has the effect of masking the noise produced by the turbine, also increases. The assessment of noise from wind farms considers the variation of noise output with change in wind. As a reference the sound power level of a wind turbine at a wind speed of 8 m/s is often used in the industry as this is about the level at which the sound of a wind turbine is most noticeable.

The variation in output for the Suzlon S88 turbine is displayed in Table 2-1.

Wind speed [m's at 10m AGL)	Sound Power Level [dB(A)]
3	103.4
4	104.1
5	104.7
6	105.2
7	105.6
8	105.9
9	106.1
10	106.2

Table 2-1: SUZLON S88-2.1 Sound emission

First interim results of noise tests conducted by DEWI[5] indicate that actual sound emissions will be lower than the guaranteed emissions shown in Table 2-1 with 104.9 dB(A) at 8m/s compared to 105.9 dB(A) as per Table 2-1.

3 Noise Guidelines

The assessment of sound levels produced by the Black Springs Wind Farm has been undertaken as per the *South Australian Environmental Protection Agency (SA EPA) Environmental Noise Guideline: Wind Farms (SA EPA Guidelines[6]).* This guideline has been applied for the development of wind farms in NSW, Victoria and South Australia and is referenced in the NSW Planning draft document, *Planning Guidelines for Wind Farms.*

The SA EPA Guidelines require that the equivalent noise level (L_{Aeq}) due to wind turbine noise at a residence, measured at a level of 2m above ground adjusted for tonality is a maximum of 35 dB(A) or the background sound power level (L_{A90}) plus 5 dB(A), whichever is greater. The levels stated are at a reference wind speed range from cut-in wind speed (4 m/s) to rated power of the wind turbine (12m/s) at 10m above the ground. Although the noise output of a turbine increases with wind speed it is accepted that at speeds in excess of 8m/s the background noise generated by the wind generally has a significant masking affect. As the SUZLON S88 does not show a specific tonality in its noise emissions, no adjustment for tonality has been made.

4 Noise is described as "white" noise when it does not have a specific tonality and frequency spectrum but ranges across a large frequency band.

5 Deutsches Windenergie Institut GmbH, 22/11/2005

6 Wind Farms: Environmental Noise Guidelines, Environmental Protection Authority of South Australia, February 2003

4 Noise Prediction Model

The prediction of the sound pressure levels at the receiver locations was based on a conservative hemispherical spreading model based on ISO 9613-2[7]. The calculation considers the variation in terrain based on a digital elevation model and assumes a specific terrain surface as represented in the project area of 1 dB/km (ground covered with grass) as well as a general atmospheric attenuation of 2 dB/km. The calculation makes no allowance for vegetation such as trees or any other obstacles potentially masking the sound distribution. Although the model is considered to be simple, the assumptions result in generally conservative results, particularly in the case where significant vegetation exists between the source and receivers. The model referenced to in the SA EPA Guidelines to calculate the noise emissions is specified in ISO 9613. This model uses the 1/3 octave band sound emissions from a given turbine as basis for the calculation. As this spectral noise distribution was not available at the time of this report, the simple noise model using an overall sound pressure level at a given wind speed has been used. As the simple noise model generally calculates higher noise levels than the ISO 9613 specification, it is seen as conservative and appropriate. The SA EPA Guidelines allow the selection of a suitable model and as the simple noise model is considered to represent the worst case this is deemed acceptable.

The noise modelling was undertaken with the Windfarmer™ software package. Windfarmer is a specialised wind farm analysis tool developed by the leading consulting firm Garrad Hassan.

The following assumptions are made in the calculation of predictions;

- The turbine noise emits from a point source at hub-height (80mAGL)
- Receivers are located 2m above the ground
- The turbine noise output varies with wind speed as per Table 2-1
- The ground is considered to be a soft surface covered with grass and non-reflecting
- Attenuation occurs at a rate of 2 dB per km (atmospheric) and 1 dB per km (porous surface)
- There is no vegetation or other attenuating structure between the wind turbine and the receiver (trees around houses are not considered in the prediction).

Although the model does not consider other atmospheric conditions such as air density or humidity, the results obtained from the model have previously compared well with those obtained from complex models based on worst-case atmospheric conditions. The estimated error in the prediction is 2-3 dB.

5 Background Noise

As the wind speed increases at a residence there is a natural increase in the ambient or background noise level. The characteristic of the background sound level will depend upon levels and types of vegetation, nature of structures and degree of exposure. The SA EPA Guidelines acknowledge that the background noise (natural or otherwise) can provide masking affect that reduces the intrusiveness of noise generated by turbines. When background noise levels at a residence are monitored and then analysed with reference to simultaneous wind speed measurements, an adjusted limit can be established.

Background noise levels were monitored at 3 of the residences considered in this study of which three locations are deemed to be relevant for the wind farm site. The locations of the three relevant sites selected for background noise monitoring are shown in Figure 5-3. These background noise measurements have been conducted by Garrad Hassan from 11-02-2005 to 11-03-2005 using equipment from Acoustic Research Laboratories Model EL-315, Type 2 with an accuracy of ±1 dB. As part of the analysis, rainfall data was obtained from the Bathurst Airport BoM station and checked for its validity with local rain gauge measurements recorded by Gavin Douglas at the Black Springs Site. All noise measurements undertaken during periods of rainfall have been excluded from the analysis.

[7] International Standard ISO 9613 " Acoustics – Attenuation of sound during propagation outdoors

Seasonal variation of background noise has not been considered as the measurement only occurred in February/March 2005 and covers all representative wind speeds. The main source for seasonal variation of background noise would be birdlife which is highest during spring-periods. As the measurement was during the peak summer period, the measured background noise is deemed representative. Although the sound spreading will have a more downward trend during times of temperature inversion this effect is assumed to be negligible as the sound pressure level at a specific location highly depends on the wind speed vector. The model has used a conservative factor for air absorption (Meteorological correction factor = 0) and therefore represents a worst case scenario. The International Energy Agency (IEA) and the ETSU study of noise propagation (ETSU. 2000 – ETSU/W/13/00385/REP) [8]conclude that the complex models do significantly differ from the straightforward models and therefore recommend using the straightforward spherical propagation model as used in this report. The climatic conditions on the site do not suggest that temperature inversions occur for prolonged periods and therefore the results are deemed conservative and accurate.

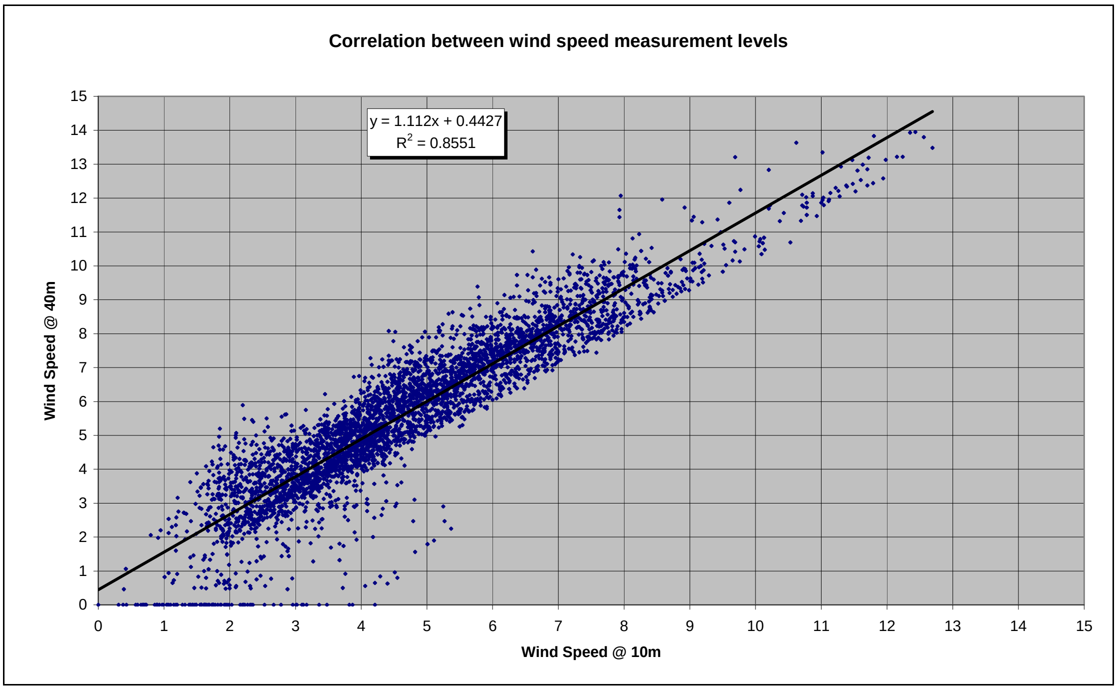


Figure 5-1: Correlation between 10m and 40m wind speed at the Daisybank Monitoring Mast

An analysis of the wind speed correlation between the 10m level and the 50m level indicates that the so called "van den Berg"-Effect of very high wind speeds at hub height even when it is almost calm at the 10m level does not have a significant relevance at this site when analysing all data irrespective of the specific daytime (Figure 5-1). The "van-den-Berg" effect is a specific situation detected by G.P. van den Berg and published in the Journal for Sound and Vibration describing the situation (especially in cold winter nights) where wind speeds at or near ground level are very low while at hub height the wind speeds are considerably higher than the normal wind shear profile would assume. This could result in a situation with no background noise at a receiver location but considerable noise impact from turbines operating at rated capacity. [9] The measurements conducted on site do not indicate such a situation being relevant as further explained below.

[8] Source: Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi

[9] Source: Sciencedirect – Effects on the wind profile at night on wind turbine sound – G.P. van den Berg, 2003

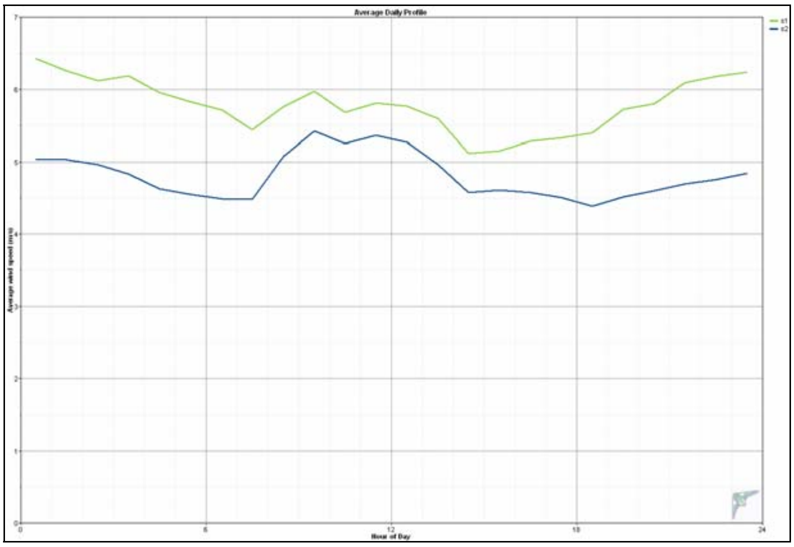


Figure 5-2: Daily Wind Speed Profile

To further analyse the potential impact of variations in wind shear on the noise prediction a detailed analysis of the specific daily wind shear profile was calculated. Although the wind shear varies from day to night with higher wind shear exponents during the night this has to be treated with caution. The "van den Berg" report analysed a small wind farm at almost sea level in absolutely flat terrain with no impact on wind flows by topography, vegetation or obstacles. Black Springs is in undulating terrain and at an altitude of 1,210m a.s.l. and as such topographic influences and the lower air density will most likely result in a lower impact of the higher wind shear at night on noise as the noise propagation is significantly affected by the terrain. To assess the potential impact the wind speed at hub height for various wind shear exponents was calculated.

Table 5-1 shows the daily wind shear profile as roughness length which is generally used as indicator for the difference between measurement height wind speed and hub height wind speed (logarithmic formula). This wind shear profile then was used to calculate the hub height (80m) wind speed for various 10m-wind speeds as shown in Table 5-2. This data was then used to calculate the turbine sound emissions at various roughness lengths as shown in Table 5-3.

Hour	Surface Roughness [m]
0	0.066800
1	0.033650
2	0.025872
3	0.069967
4	0.080791
5	0.069830
6	0.063691
7	0.015861
8	0.000340
9	0.000010
10	-
11	0.000001
12	0.000004
13	0.000205
14	0.000094
15	0.000076
16	0.001425
17	0.004913
18	0.024403
19	0.056230
20	0.049402
21	0.093698
22	0.098499
23	0.080909

Table 5-1: Roughness Length factors in m

Wind Speed at 10m [m/s]	Wind Speed at hub height [m/s]			
	Roughness Length [m]			
	0.01	0.03	0.05	0.1
1	1.30	1.36	1.39	1.45
2	2.60	2.72	2.78	2.90
3	3.90	4.07	4.18	4.35
4	5.20	5.43	5.57	5.81
5	6.51	6.79	6.96	7.26
6	7.81	8.15	8.35	8.71
7	9.11	9.51	9.75	10.16
8	10.41	10.86	11.14	11.61
9	11.71	12.22	12.53	13.06
10	13.01	13.58	13.92	14.52
11	14.31	14.94	15.32	15.97
12	15.61	16.30	16.71	17.42
13	16.91	17.65	18.10	18.87
14	18.21	19.01	19.49	20.32
15	19.52	20.37	20.89	21.77

Table 5-2: Wind speed at hub height (80m)

Wind Speed at 10m [m/s]	Turbine Sound Emission [dB(A)]			
	Roughness Length [m]			
	0.01	0.03	0.05	0.1
1	-	-	-	-
2	-	-	-	-
3	-	104.2	104.2	104.4
4	104.8	105.0	105.0	105.1
5	105.4	105.5	105.6	105.7
6	105.8	105.9	105.9	106.0
7	106.0	106.1	106.1	106.1
8	106.1	106.2	106.2	106.2
9	106.2	106.2	106.1	106.1
10	106.1	106.1	106.1	106.0
11	106.1	106.0	106.0	106.0
12	106.0	106.0	106.0	106.0
13	106.0	106.0	106.0	106.1
14	106.0	106.1	106.2	106.3
15	106.2	106.3	106.5	106.7

Table 5-3: turbine sound emissions

As can be seen from the tables above the difference in noise emissions between the lowest roughness length and the highest roughness length at critical wind speeds of 4-6m/s at 10m is maximum 0.3 dB(A). This is well within the model accuracy and it is therefore not considered necessary to take the "van den Berg" effect into account.

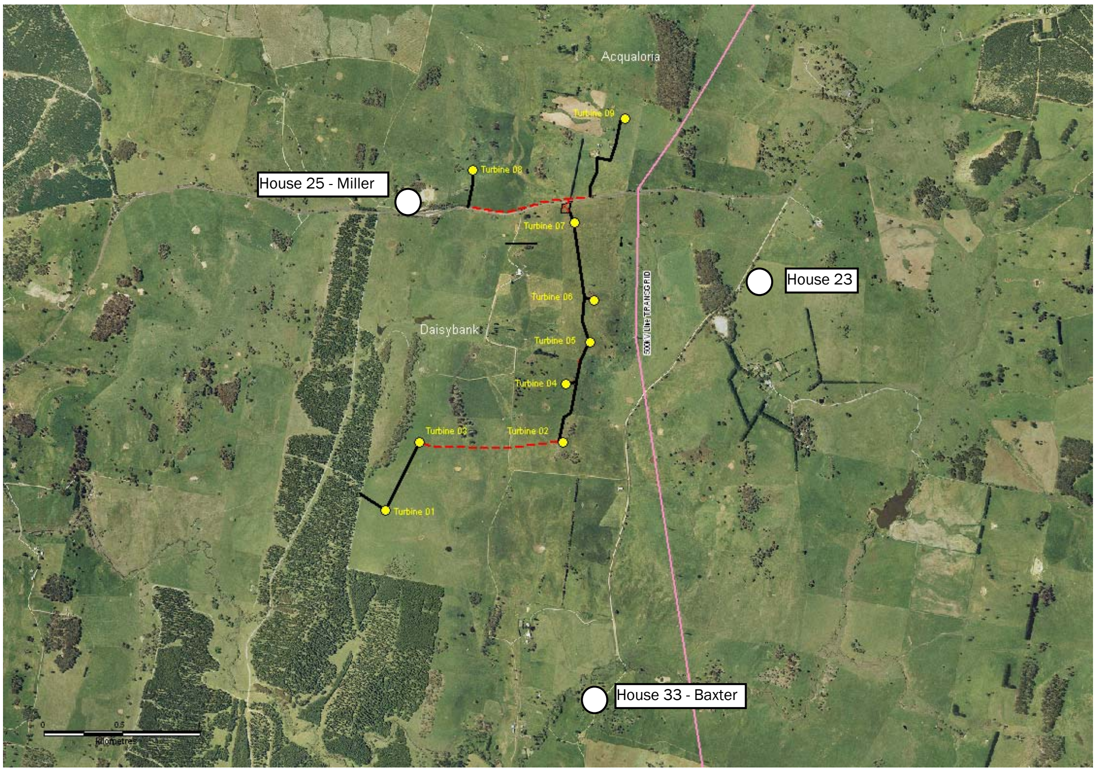


Figure 5-3: Background Noise Monitor Locations and turbine layout

5.1 Relevance of background noise monitoring stations

To assess background noise it is required to select locations closest to the wind farm project which are representative of the sound environment in the area. It is important to select locations which are not exposed to higher than normal noise level to avoid bias and allow a conservative assessment.

House 33 (Baxter) is located at the end of Swatchfield Road in a comparatively quiet environment and representative of the residences in this location (32-35). No through traffic is expected here so it can be assumed that this location represents the quietest background noise environment. The house is not surrounded by a large number of trees and as such very limited background noise from leaves is expected.

The noise monitor for House 23 was located at Swatchfield Road and the background noise monitor was installed in a paddock adjacent to the road. Although it was not placed near a house (e.g. house 23 or house 22) putting the noise monitor in this position is deemed to be conservative as it location is significantly off the main road and as such noise generated by traffic driving on the Black Springs – Burraga Road has little impact on this location resulting in a lower background noise level than what would be expected when placing the noise monitor at the residence itself. As it was not possible to contact the residents/owners of house 23 before the noise monitoring campaign, the developer decided to place the monitor in open farmland.

The noise monitor for House 25 was located near the Miller residence and is deemed to be representative of locations alongside the east-west stretch of the Black Springs Burraga Road.

5.2 Baxter Residence (Receiver 01 – House 33)

The Baxter residence (House 33) is located to the South of the proposed development (coordinates 750624E 6246715N UTM WGS84 Zone 55) with the receiver installed approximately 15m north-west of the house. Background noise levels were monitored at this location over the period 11-02-2005 until 11-03-2005.

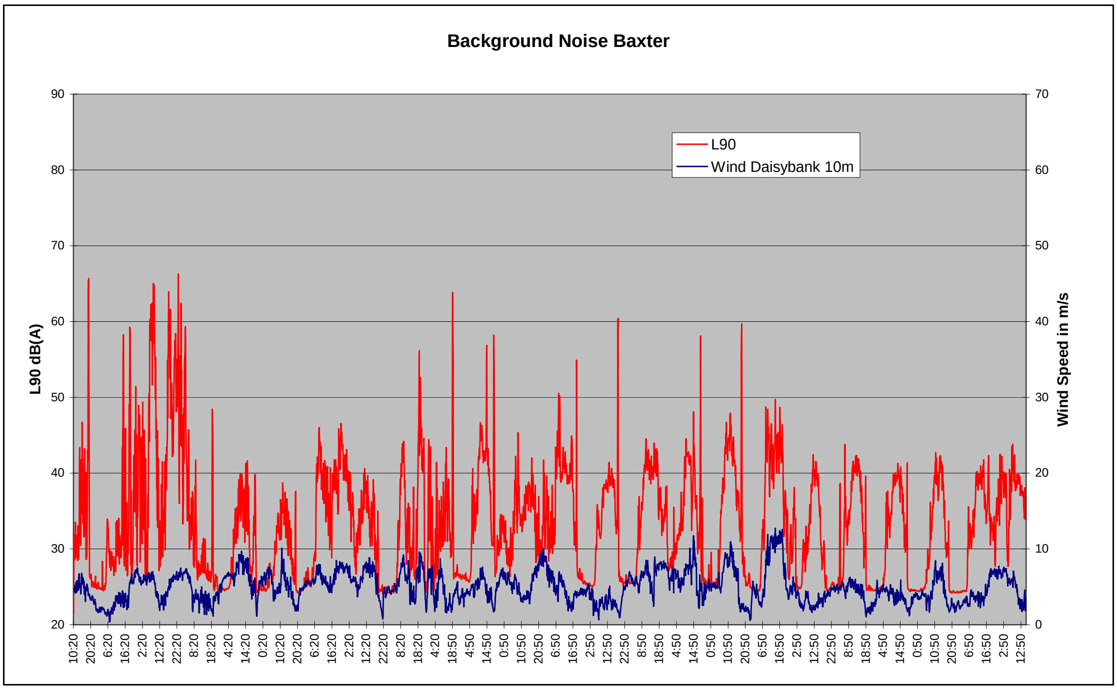


Figure 5-4: Ambient Sound level (L90, dB(A)) at the Baxter residence and concurrent wind speed (10m) on Daisybank

Figure 5-5 displays the logged sound pressure level (L_{A90}) against wind speed as well as the second order polynomial regression line. A total of 3,318 10-min data points was used which is considered representative[10].

Although the third order polynomial regression line results in a better correlation factor the third order shows an incorrect shape at high wind speeds. With the second order polynomial regression line being very close in its correlation quality to the third order the second order polynomial regression has been used. The polynomial regression line has been applied for wind speeds in excess of 2.94 m/s[11] at 10m (cut-in wind speed of turbine 4 m/s at hub height) and less than 18 m/s[12] resulting in a total of 2,347 data sets for the regression analysis.

Regression order	Correlation (R^2)
1	0.1581
2	0.1643
3	0.1676

Table 5-4: Correlation R^2 factors Baxter Residence

[10] A minimum of 2,000 data points is considered as sufficient in the SA EPA Guidelines

[11] The cut-in wind speed of this turbine is 4 m/s equalling 2.9 m/s at 10m a.g.l.

[12] The cut-out wind speed of this turbine is 25 m/s equalling 18 m/s at 10m a.g.l.

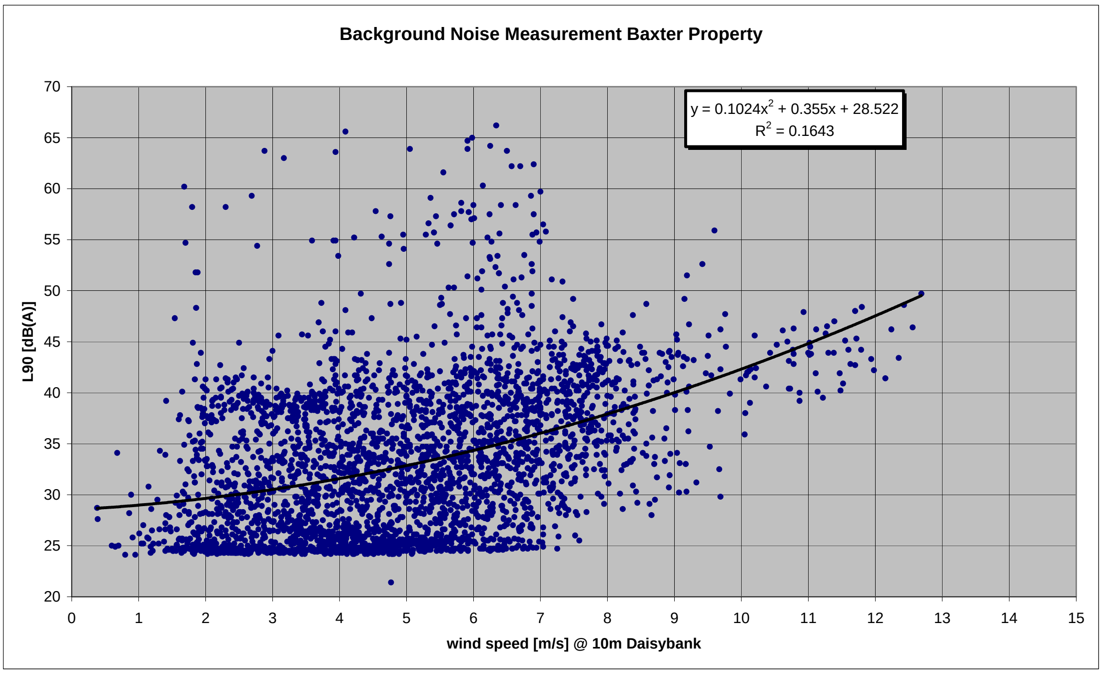


Figure 5-5: Background Noise Measurement Results Baxter

This background noise measurement shows a minimum background noise level of approximately 31 dB(A) at the cut-in wind speed of 2.94m/s with an average sound pressure level of 37 dB(A) at 8m/s[13]. The second order regression line was then used and plotted against the predicted sound power level generated by the proposed project. As per the SA EPA Guidelines a maximum sound pressure level of 35 dB(A) or background noise + 5 dB(A) is acceptable. The results are shown in Figure 5-6. The maximum noise level generated by the wind farm at 8m/s is 36.4 dB(A).

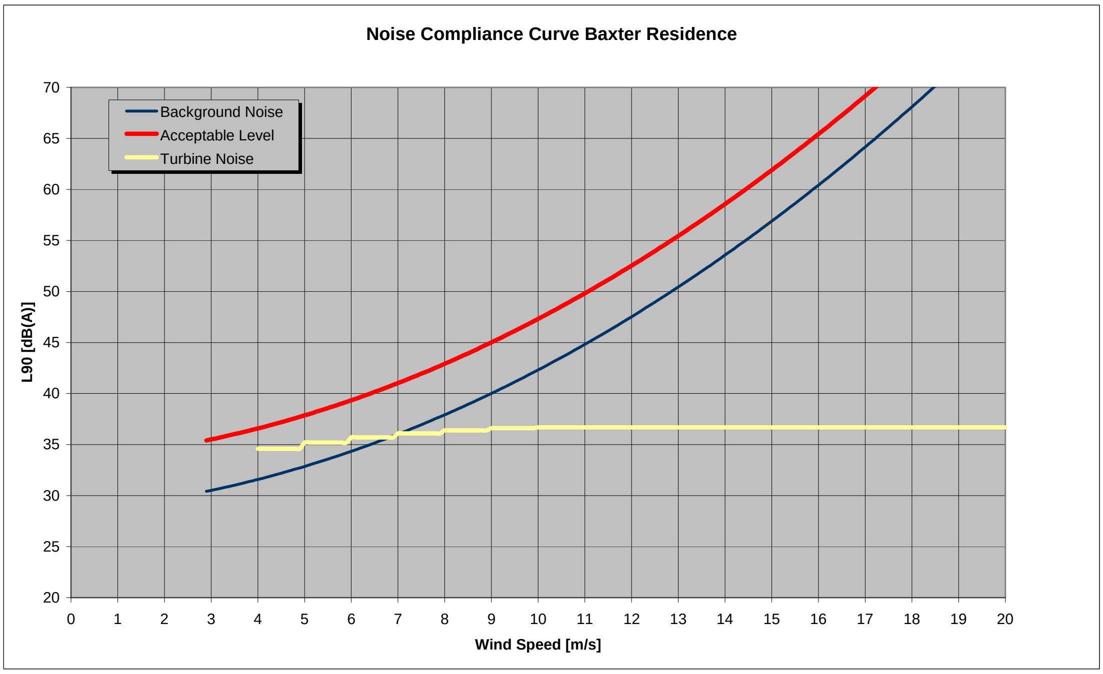


Figure 5-6: Noise Compliance Check Baxter

[13] Based on the regression curve, not individual measurements

The calculated sound pressure level at the Baxter residence caused by the wind farm is for all wind speeds lower than the maximum acceptable noise level and therefore the wind farm complies with the applicable noise limits at this particular residence.

5.3 House 23 Residence (Receiver 02)

The House 23 background noise measurement was done immediately outside the boundary of the house 23 property approximately 450 m to the south west of the house. The location is north-west of the proposed development (coordinates 751691E 6249489N UTM WGS84 Zone56). Background noise levels were monitored at this location over the period 11-02-2005 until 11-03-2005.

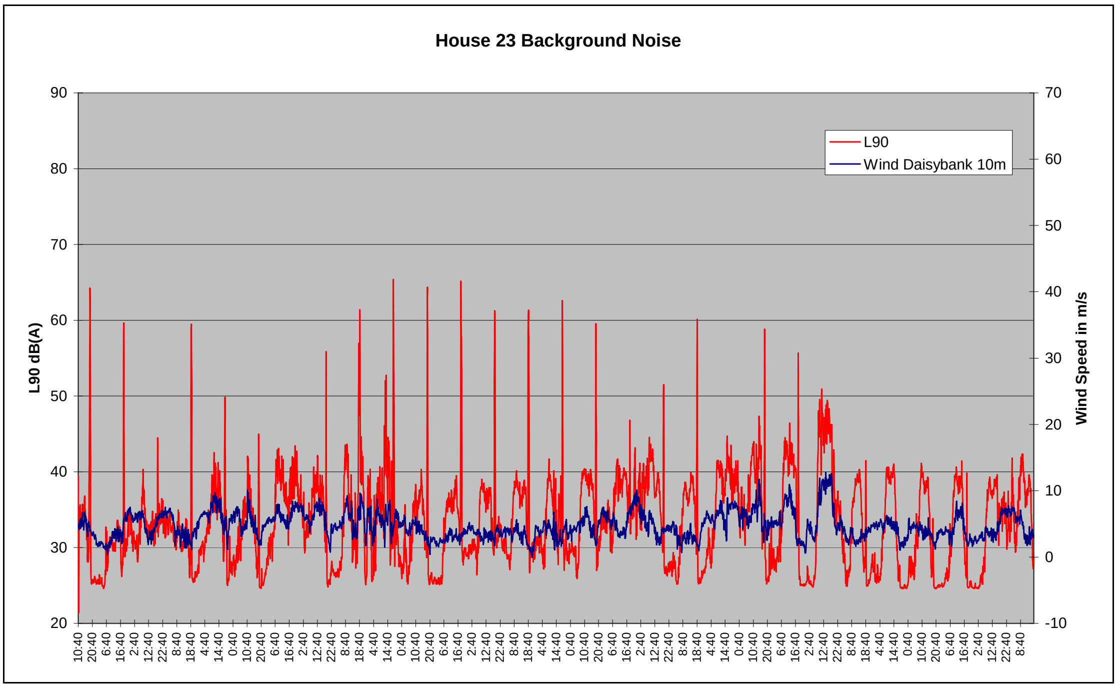


Figure 5-7: Ambient sound levels (L90, dB(A)) at House 23 and concurrent wind speed (10m) on Daisybank

Figure 5-8 displays the logged sound pressure level (L_{90}) against wind speed as well as the second order polynomial regression line. A total of 4,067 10-min data points was used which is considered representative[14].

Although the third order polynomial regression line results in a better correlation factor the third order shows an incorrect shape at high wind speeds. With the second order polynomial regression line being very close in its correlation quality to the third order the second order polynomial regression has been used. The polynomial regression line has been applied for wind speeds in excess of 2.94 m/s at 10m (cut-in wind speed of turbine 4 m/s at hub height) and less than 18 m/s (cut-out wind speed of turbine) resulting in a total of 2,268 data sets for the regression analysis.

Regression order	Correlation (R^2)
1	0.2048
2	0.2239
3	0.2242

Table 5-5: Correlation R^2 factors House 23 Residence

[14] A minimum of 2,000 data points is considered as sufficient in the SA EPA Guidelines

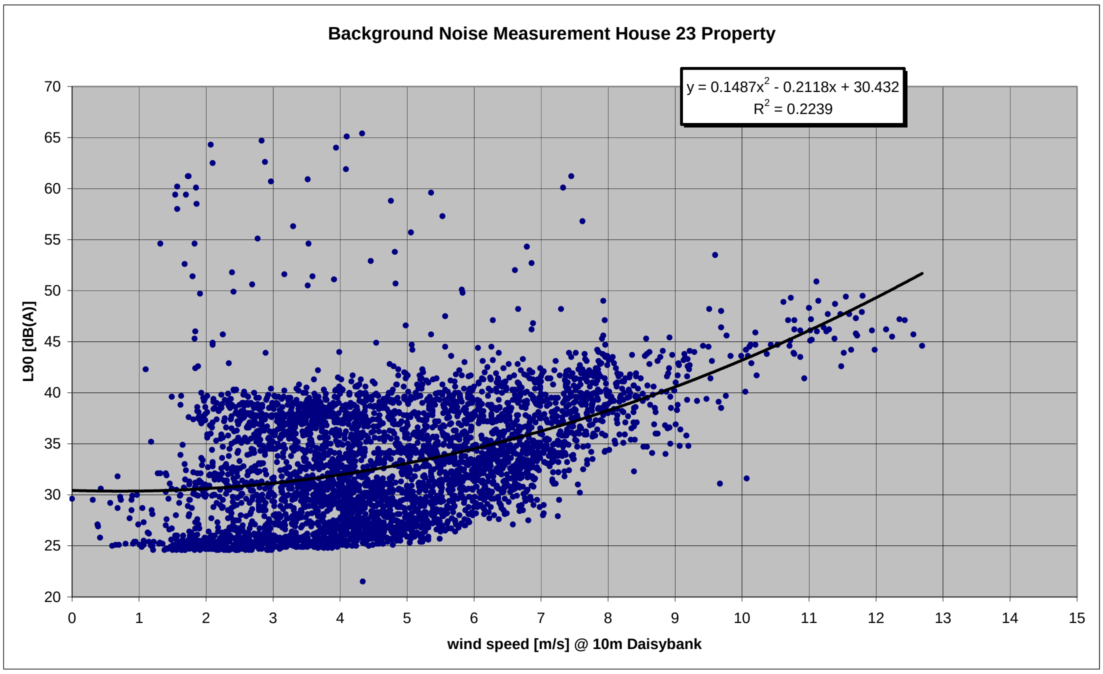


Figure 5-8: Background Noise Measurement Results House 23

This background noise measurement shows a minimum background noise level of approximately 32 dB(A) at the cut-in wind speed of 2.9m/s with an average sound pressure level of 37 dB(A) at 8m/s. The second order regression line was then used and plotted against the predicted sound power level generated by the proposed project. As per the SA EPA Guidelines a maximum sound pressure level of 35dB(A) or background noise + 5 dB(A) is acceptable. The results are shown in Figure 5-9. As no particular background measurement was conducted at the house itself but in open farmland away from the main roads, it is a reasonably conservative assumption to use the results of this background noise measurement as probable background noise at the house itself (coordinates of house 752162E, 6250018N UTM WGS84 Zone 56). The maximum noise generated by the wind farm at this property at a wind speed of 8m/s is 38.7 dB(A).

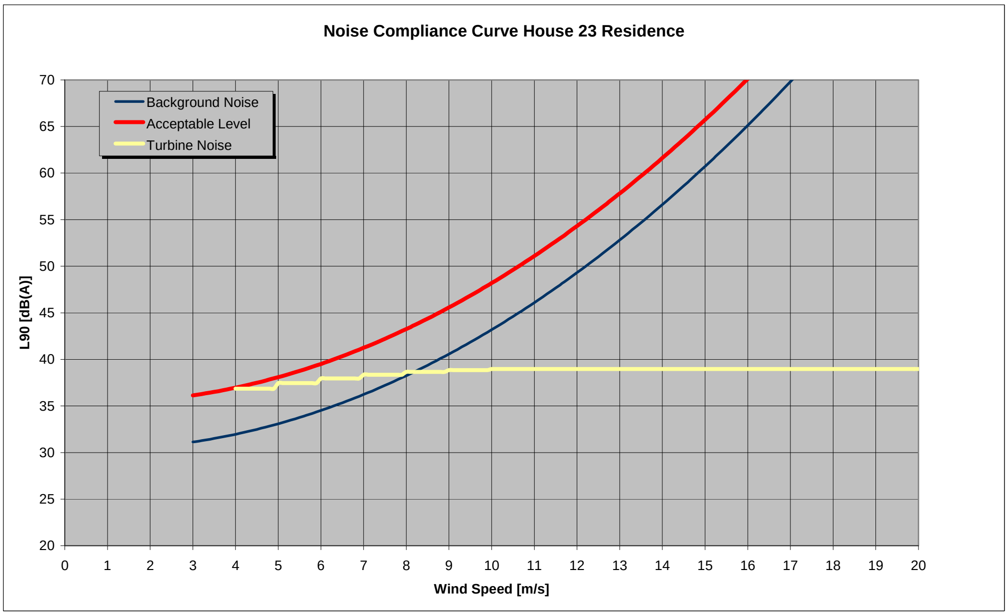


Figure 5-9: Noise Compliance Check House 23

The calculated sound pressure level at the House 23 residence caused by the wind farm is for all wind speeds lower than the maximum acceptable noise level and therefore the wind farm complies with the applicable noise limits at this particular residence.

5.4 Miller Residence (House 25 - Receiver 03) – (non relevant as noise agreement signed)

The Miller Residence (House 25) background noise measurement was done 20m to the east of the house (Coordinates: 749410E, 6249951N UTM WGS84 Zone56). Background noise levels were monitored at this location over the period 11-02-2005 until 11-03-2005.

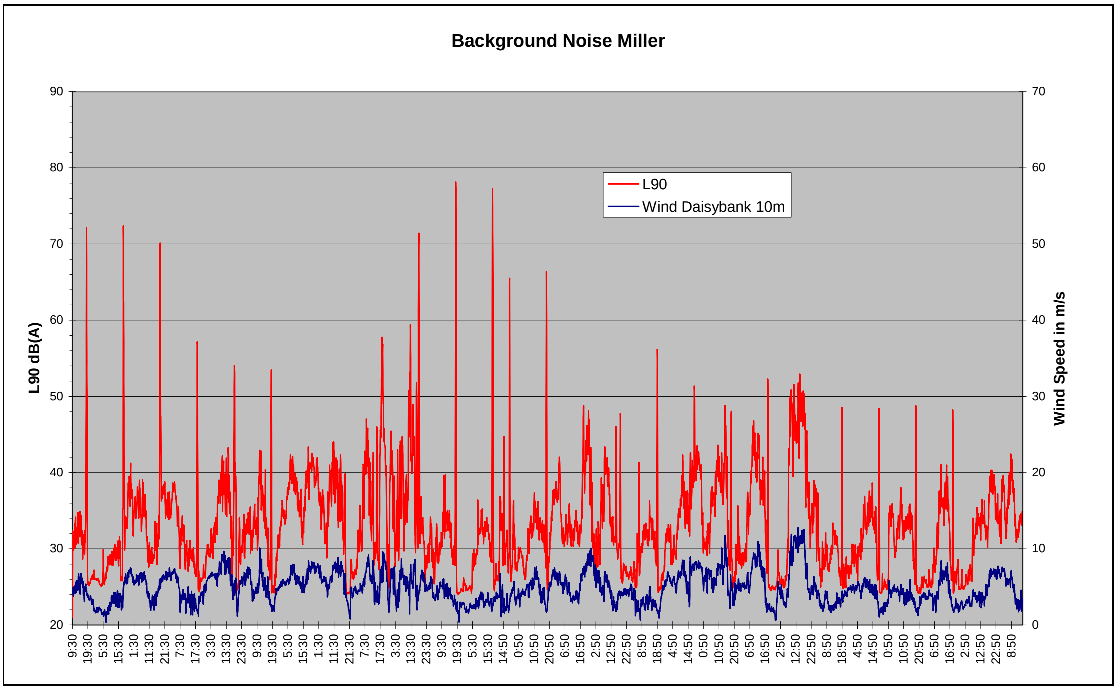


Figure 5-10: Ambient sound levels (L90, dB(A)) at the Miller residence and concurrent wind speed (10m) at Daisybank

Figure 5-11 displays the logged sound pressure level (L_{90}) against wind speed as well as the second order polynomial regression line. A total of 3,704 10-min data points was used which is considered representative[15].

Although the third order polynomial regression line results in a better correlation factor the third order shows an incorrect shape at high wind speeds. With the second order polynomial regression line being very close in its correlation quality to the third order the second order polynomial regression has been used. The polynomial regression line has been applied for wind speeds in excess of 2.94 m/s at 10m (cut-in wind speed of turbine 4 m/s at hub height) and less than 18 m/s (cut-out wind speed of turbine) resulting in a total of 3,031 data sets for the regression analysis.

Regression order	Correlation (R^2)
1	0.3693
2	0.3798
3	0.3830

Table 5-6: Correlation R^2 factors House 25 Residence

[15] A minimum of 2,000 data points is considered as sufficient in the SA EPA Guidelines

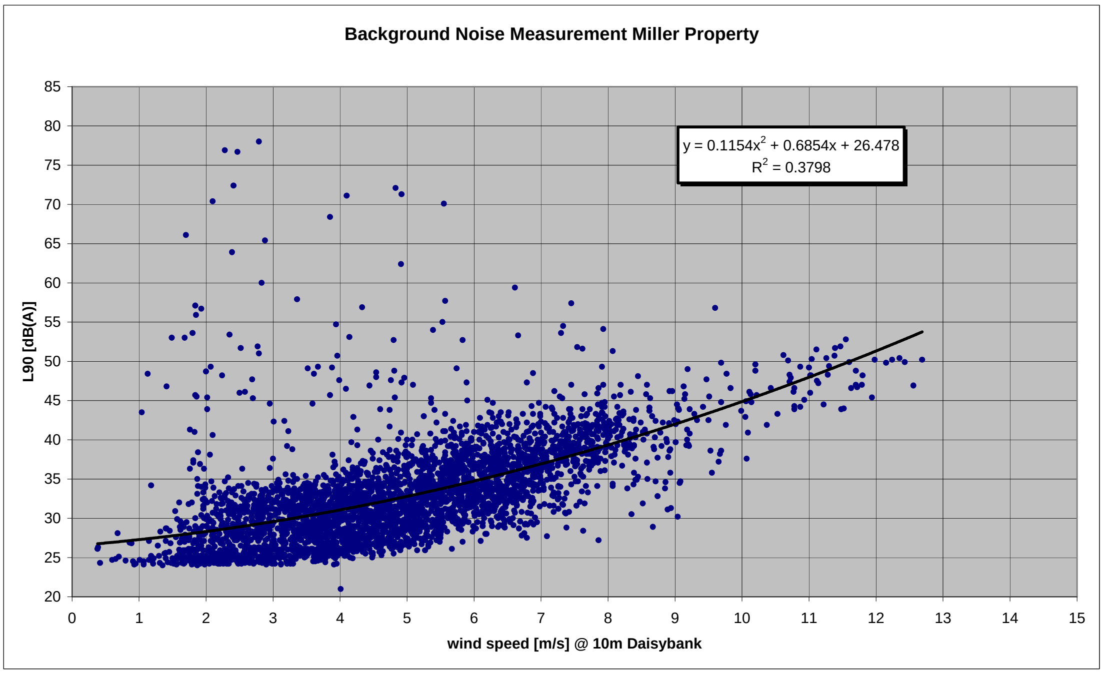


Figure 5-11: Background Noise Measurement Results Miller

This background noise measurement shows a minimum background noise level of approximately 28 dB(A) at the cut-in wind speed of 2.9m/s with an average sound pressure level of 39 dB(A) at 8m/s. The second order regression line was then used and plotted against the predicted sound power level generated by the proposed project. As per the SA EPA Guidelines a maximum sound pressure level of 35 dB(A) or background noise + 5 dB(A) is acceptable. As a noise acceptance agreement[16] has been signed with the landowner stating a maximum noise limit of 50 dB(A) at this property, this noise level applies. The results are shown in Figure 5-12. The maximum noise generated by the wind farm at this property at a wind speed of 8m/s is 44.8 dB(A).

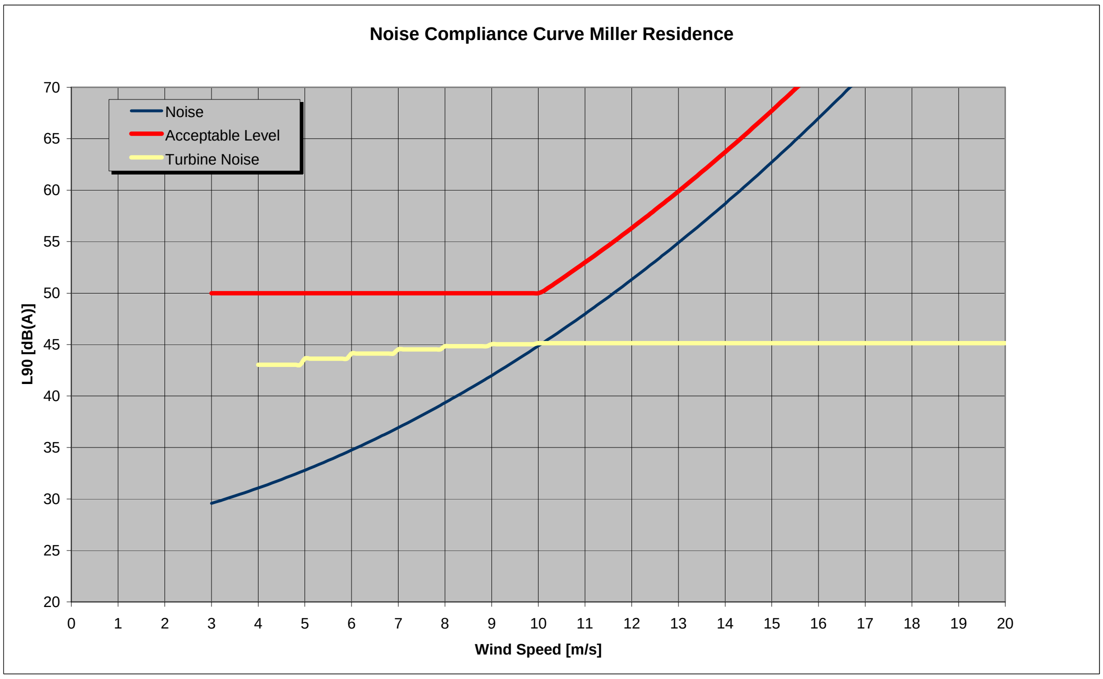


Figure 5-12: Noise Compliance Check Miller

[16] Source: Developer

As this house residence has accepted a higher noise limit of 50 dB(A) as maximum the wind farm complies with the acceptable noise limits at this residence.

5.5 General assumptions for houses with no background noise measurement

The background noise measurement conducted is deemed to be representative for the area and therefore the following noise limits will be applied to the houses, where no background noise measurement was done:

- Baxter Residence – all houses south of the project
- House 23 – all houses east of the project up to Winton Park turn-off
- Miller Residence – all houses north of the project and along Oberon-Burraga Road

This approach is considered conservative and appropriate as the background noise measurement sites were in similar areas to the houses were no background noise measurement has been undertaken. Especially in the case of House 23 the noise receiver was sited on a location well off the main road while most houses where this receiver is considered to be relevant are actually located either in a similar area (Winton Park) or closer to the main road and thus expected to experience higher background noise than measured by this receiver.

Therefore the applicable noise limits for the relevant residences would be:

Receiver	Reference	Applicable sound pressure level at residence [dB(A)] at wind speed in m/s										
		4	5	6	7	8	9	10	11	12	13	14
20	House 23	37.4	38.0	39.2	40.8	42.9	45.5	48.5	52.1	56.1	60.6	65.6
21	House 23	37.4	38.0	39.2	40.8	42.9	45.5	48.5	52.1	56.1	60.6	65.6
22	House 23	37.4	38.0	39.2	40.8	42.9	45.5	48.5	52.1	56.1	60.6	65.6
23	House 23	37.4	38.0	39.2	40.8	42.9	45.5	48.5	52.1	56.1	60.6	65.6
24	Miller	36.1	37.8	39.7	41.9	44.3	47.0	49.9	53.0	56.3	59.9	63.7
25	Miller	36.1	37.8	39.7	41.9	44.3	47.0	49.9	53.0	56.3	59.9	63.7
27	Miller	36.1	37.8	39.7	41.9	44.3	47.0	49.9	53.0	56.3	59.9	63.7
28	Miller	36.1	37.8	39.7	41.9	44.3	47.0	49.9	53.0	56.3	59.9	63.7
29	Baxter	36.6	37.9	39.3	41.0	42.9	45.0	47.3	49.8	52.5	55.4	58.6
31	House 23	37.4	38.0	39.2	40.8	42.9	45.5	48.5	52.1	56.1	60.6	65.6
32	Baxter	35.8	37.6	39.3	41.2	43.1	45.1	47.1	49.2	51.4	53.7	56.0
33	Baxter	35.8	37.6	39.3	41.2	43.1	45.1	47.1	49.2	51.4	53.7	56.0
34	Baxter	35.8	37.6	39.3	41.2	43.1	45.1	47.1	49.2	51.4	53.7	56.0
35	Baxter	35.8	37.6	39.3	41.2	43.1	45.1	47.1	49.2	51.4	53.7	56.0

Table 5-7: applicable Noise Limits at relevant residences[17]

6 Black Springs Wind Farm

The Black Springs Wind Farm will occupy two farm areas, "Aqualoria" and "Daisybank". For the purpose of the study a representative layout of 9 Suzlon S88 turbines with an 88m rotor diameter and an 80m hub height has been used. Within the vicinity of the site there are 14 residences which may experience some noise impact from the wind farm (see Figure 6-1). The residences positions have been established through map review and site survey and are listed in Table 6-1.

[17] Only houses with wind farm noise > 34dB(A) are listed in this table. House where wind farm noise is predicted to be less than 34 dB(A) are not considered as relevant

Figure 6-1: Turbine Layout and Residences

Of the 14 potential noise receivers, 10 are considered as "relevant" as they are not contractually involved in the project. Residences contractually involved in the project have signed noise acceptance agreements with the developer accepting a maximum noise level generated by the wind farm of 50 dB(A). This noise limit has been used for the assessment of these properties. The developer has also signed a noise acceptance agreement with Receiver 25 (Miller) allowing a maximum sound pressure level at this residence of 50 dB(A).

The contractual noise limit for such residences of 50 dB(A) is considered reasonable as the landowners have been informed[18] about this impact, a formal agreement has been reached[19] and the impact of this disposure is unlikely to result in adverse health impacts.

18 The information was done by showing the respective landowner the noise level of 50dB(A) using a handheld noise meter and explaining the potential impact in detail. Note the 50dB(A) level is measured outside a dwelling resulting in a significantly lower noise level inside the house. The landowner was encouraged to make his own assessment and gain information and the agreement was signed on a fully informed basis

19 Information provided by developer

Receiver No.	Closest Turbine	Distance to Closest Turbine (m)	WGS84 Zone 56 UTM Coordinates		Relevant Receiver
			Easting (m)	Northing (m)	
20	9	1,228	751880	6250600	Yes
21	9	1,561	752275	6250190	Yes
22	9	1,447	752151	6250042	Yes
23	9	1,402	751941	6249533	Yes
24	9	316	750492	6249986	No
25	8	484	749270	6249750	No
27	7	504	750004	6249216	No
28	3	467	749393	6248591	No
29	1	1,072	748320	6247030	Yes
31	5	1,156	751614	6248514	Yes
32	1	1,158	750080	6246960	Yes
33	2	1,615	750520	6246520	Yes
34	1	1,533	750120	6246480	Yes
35	1	1,793	749630	6245950	Yes

Table 6-1: Noise Receiver Locations (Residences)

7 Results

Calculation of noise impacts was carried out for the 14 receivers within the vicinity of the site. The results are presented for the reference wind speed range of 4 m/s to 14 m/s at a height of 10m above the ground. Results marked in bold red show that the applicable limit is exceeded. Results in italic letters show non-relevant receiver locations.

Receiver	Predicted sound pressure level at residence [dB(A)] at wind speed in m/s											
	4	5	6	7	8	9	10	11	12	13	14	Maximum exceedance [dB(A)]
20	35.2	35.8	36.4	36.8	37.1	37.3	37.4	37.4	37.4	37.4	37.4	0
21	33.9	34.5	35.1	35.5	35.8	36.0	36.1	36.1	36.1	36.1	36.1	0
22	34.9	35.5	36.1	36.5	36.8	37.0	37.1	37.1	37.1	37.1	37.1	0
23	36.8	37.4	38.0	38.4	38.7	38.9	39.0	39.0	39.0	39.0	39.0	0
24	*47.7*	*48.3*	*48.9*	*49.3*	*49.6*	*49.8*	*49.9*	*49.9*	*49.9*	*49.9*	*49.9*	*0*
25	*42.9*	*43.5*	*44.1*	*44.5*	*44.8*	*45.0*	*45.1*	*45.1*	*45.1*	*45.1*	*45.1*	*0*
27	*46.4*	*47.0*	*47.6*	*48.0*	*48.3*	*48.5*	*48.6*	*48.6*	*48.6*	*48.6*	*48.6*	*0*
28	*44.4*	*45.0*	*45.6*	*46.0*	*46.3*	*46.5*	*46.6*	*46.6*	*46.6*	*46.6*	*46.6*	*0*
29	35.9	36.5	37.1	37.5	37.8	38.0	38.1	38.1	38.1	38.1	38.1	0
31	**39.0**	**39.6**	**40.2**	40.6	40.9	41.1	41.2	41.2	41.2	41.2	41.2	1.6
32	**38.1**	**38.7**	39.3	39.7	40.0	40.2	40.3	40.3	40.3	40.3	40.3	2.3
33	34.5	35.1	35.7	36.1	36.4	36.6	36.7	36.7	36.7	36.7	36.7	0
34	34.9	35.5	36.1	36.5	36.8	37.0	37.1	37.1	37.1	37.1	37.1	0
35	32.2	32.8	33.4	33.8	34.1	34.3	34.4	34.4	34.4	34.4	34.4	0

Table 7-1: Noise Level Prediction at Receiver Locations[20]

Figure 7-1 shows the Sound Pressure Level Contour Map of the proposed development with Iso-Lines[21] showing the sound pressure level in 5 dB(A) intervals (solid lines) and 1 dB(A) intervals (dotted lines).

[20] Italic numbers show non-relevant receivers, bold and red numbers show noise levels above acceptable limit

[21] An ISO line is a contour line representing the same noise level

Figure 7-1: Sound Pressure Level Contour Map

8 Conclusion

A noise limit of 35 dB(A) or background noise + 5 dB(A) whichever is greater at receivers in the vicinity of the wind farm has been considered as defined by the NSW Planning Guidelines and set out in the SA EPA Guidelines which were adapted by the Government of NSW for the assessment of wind farm projects.

In addition, conservative estimates of the variation in background noise level with change in wind speed, based on local measurement, have been used to determine the appropriate adjusted noise limit at residences. The results of the predictive calculations indicate that all the relevant residents in the immediate vicinity of the Black Springs Wind Farm broadly comply with the base 35 dB(A) and background adjusted limits of the SA EPA Guidelines. The small exceedance of maximum 2.3 dB(A) in one residence (House 32) and 1.6 dB(A) in another residence (House 31) is minimal considering the model accuracy of 2 dB(A), the accuracy of the equipment used for background noise measurements and the fact that 2 dB(A) difference is hardly recognisable. House 31 (Winton Park) is surrounded by trees and shelter belts to the west of the house and therefore some masking is expected which would reduce the noise level generated by the wind farm to acceptable noise limits at this residence. It should be noted that guaranteed sound emission levels are usually well above the actual sound emissions of such turbines and therefore adding conservativeness to the model. As a result it is expected that actual sound pressure levels during the operation of the wind farm will be lower than the calculated levels.

A spectral sound emission distribution of the specific turbine model was not available at the time writing this report but SUZLON has indicated that no tonality is to be expected in the turbine which is consistent with the noise measurements for other similar turbine models.

Considering the results of the study the noise impact upon local residents is considered to be minimal.

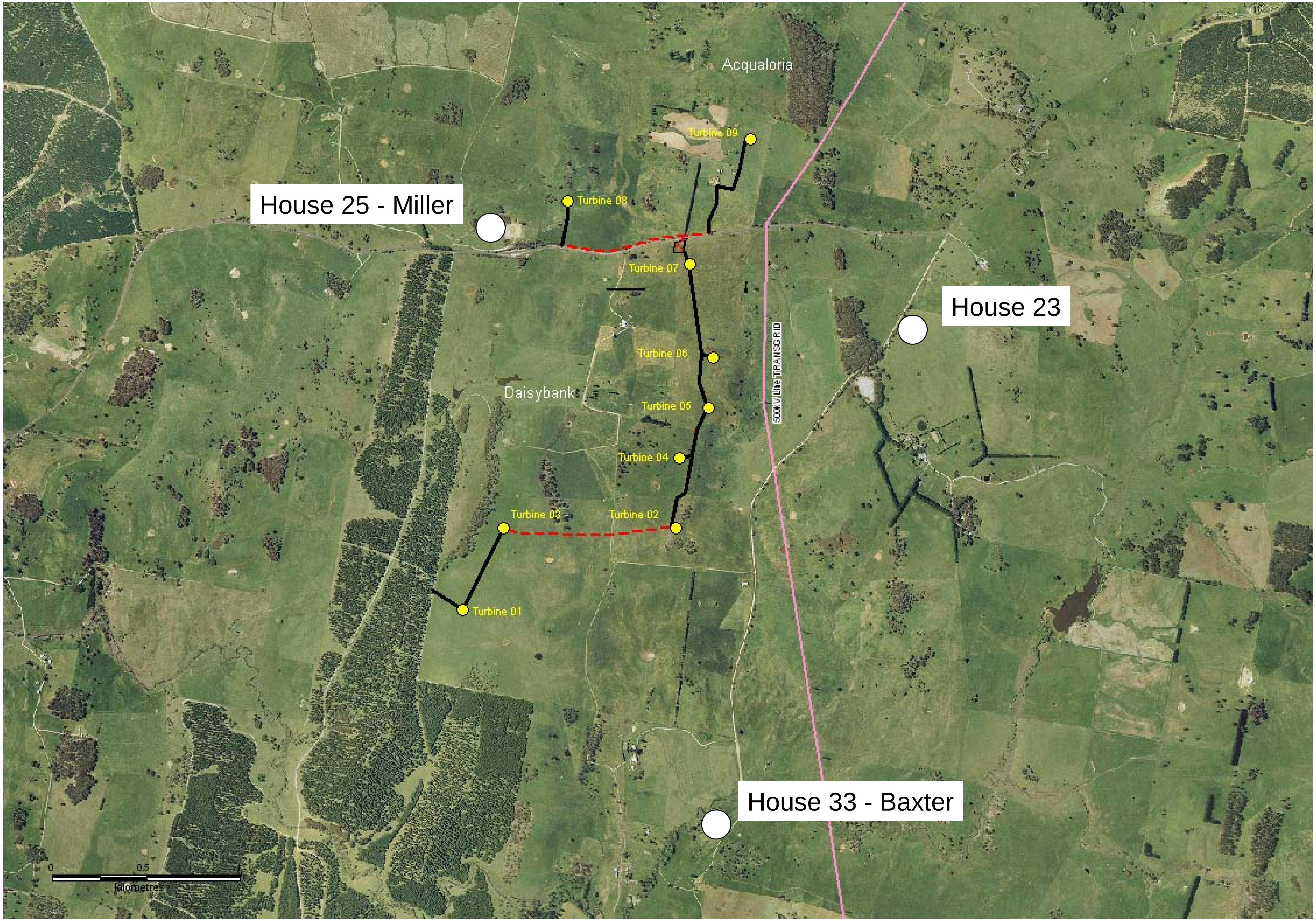
In the case where a significant level of annoyance or disturbance due to wind farm noise is experienced by a resident, and the limits presented by the SA EPA Guidelines are found to be exceeded during operation of the wind farm, mitigation measures should be investigated. Appropriate mitigation measure would be

- Installation of double-glazing for windows facing the wind farm
- Change of blade pitch to reduce noise-emissions for specific directional sectors (wind sector management). This very effective method works by using the calculated best fit polynomial regression curve of relevant background sound measurements to determine at which wind speeds noise limits are likely to be exceeded. In this location the turbine controller will get the signal to reduce the pitch of the rotor blades of the offending turbines (for example turbine 1 and 2 to reduce noise levels at house 32) to a lower noise emission. Although this results in a lower energy generation this is deemed acceptable. Such active pitching to reduce noise can result in a reduction of 2-4 dB(A). It is recommended to perform a long term background noise monitoring before construction of the wind farm to monitor background noise. The duration of such monitoring shall be long enough that addition of more data will not result in a significant change of the regression curve. Once the wind farm is operating a operational noise monitoring shall be installed at the same locations as the pre-construction monitoring to verify the actual noise levels generated by the wind farm. If this operational monitoring results in acceptable levels being exceeded the aforementioned mitigation methods shall be applied.

Appendix A

Black Springs Wind Farm - Turbine Positions

Turbine	WGS84 Zone 55 UTM Coordinates	
	Easting (m)	Northing (m)
1	749170	6247684
2	750311	6248122
3	749386	6248124
4	750333	6248503
5	750487	6248773
6	750513	6249041
7	750387	6249544
8	749736	6249883
9	750714	6250212



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Black Springs Wind Farn
Noise Report Maps

PREPARED BY: Bernhard Voll

REV A
24/04/2007

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Driving Investment, Generating Jobs:

Wind Energy as a Powerhouse for Rural & Regional Development in Australia

March 2003

by Dr Robert Passey

A Report for the Australian Wind Energy Association.

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Robert Passey, M.Sc., Ph.D., is a specialist in the field of energy policy research and analysis. His interests span both renewable energy and measures to reduce energy consumption through demand side management. Dr. Passey has worked with the Energy Policy Group of the Australian Cooperative Research Centre for Renewable Energy on a number of reports, papers and submissions to government. These included a national review of Green Power schemes and a study of the economic development and job creation potential of renewable energy systems. Dr. Passey is also a Senior Researcher for Strategic Economic Solutions, a consultancy that specialises in economic development of communities in rural and regional Australia.

About the Australian Wind Energy Association (AusWEA):

Established in 1999, AusWEA is a public company limited by guarantee. Its growing membership represents the Australian wind community, and includes organisations that own and are developing, or planning to develop, an estimated $4 billion of wind energy related projects. This includes consultants, manufacturers, those engaged in research and development, and members of the general community with an interest in developing wind turbine installations, from small remote area power systems to large wind farms.

AusWEA's objectives are:

- To raise the awareness of, and educate the Australian public about, wind energy and its potential;
- To produce reports, media releases, newsletters and Web sites for dissemination of information on industry participants and industry activities, and to organise seminars and workshops for members and other interested persons;
- To promote and facilitate research and development of wind technology in Australia;
- To contract, as Australia's representative, to the IEA Implementing Agreement for the Co-operation in the Research and Development of Wind Turbine Systems;
- To advocate policy, and represent the wind energy industry to appropriate federal, state and local government officials and elected representatives, as well as regulatory bodies, the electricity industry and consumers, committees and the general public;
- To advocate policy with wind industry groups and other interested organisations;
- To provide feedback concerning barriers to the widespread adoption of wind as an energy source;
- To actively seek affiliation with the like-minded organisations throughout the world.

Contents:

Executive Summary

> *"The Panel considers that regional Australia stands to benefit from a greater uptake of renewable generation technologies. … Alternative and renewable generation technologies, subject to the viability of cost effective greenhouse gas reduction strategies, are likely to have a particular benefit for regional Australia. Resource and land availability considerations mean that many such technologies are likely to be regionally based and bring economic benefit to regional areas."*
> (Warwick Parer, Energy Market Review report to CoAG, 2002).

Australia is already reaping significant employment and financial benefits from wind power, particularly in the rural and regional sector.

1. **Wind power is undergoing significant growth, both internationally and at home as a result of the Mandatory Renewable Energy Target (MRET) legislation.**

2. **Wind power provides jobs, income and export potential to rural and regional Australia with relatively little cost impact on end users.**

3. **International wind energy firms have selected Australia for major investments of technology and infrastructure.**

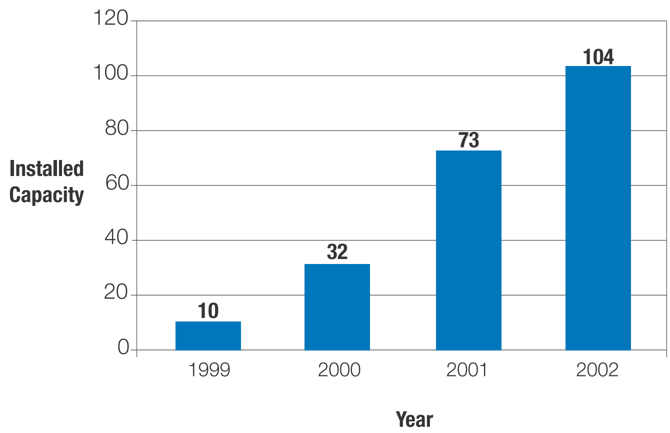
4. **But, Australia must make a clear commitment now to developing wind energy, or risk losing it's significant early-mover advantages. Stronger market creation is required to ensure future renewable energy investment.**

1. Wind power is undergoing significant growth…

...both Internationally: Wind power has been growing at over 22 percent per annum for the past 10 years.

...and domestically: There are now 104 megawatts (MW) of wind power installed and running in Australia, a further 736 MW approved or under construction, and 1,400 MW formally proposed for planning approval. This total of 2,240 MW is sufficient to supply the energy needs of approximately 800,000 homes - however, only half of this is required under the current legislation.

In Australia, an average annual growth rate of 118 percent has been achieved by the industry in the three years between 1999 and 2001.



Installed capacity growth in Australia averages 118 percent per annum.

2. Wind power provides jobs, income and export potential...

a. **Wind power is labour intensive, with a significant number of jobs generated in regional Australia.**

i. **Approximately 6.6 times as many manufacturing and installation jobs are created for wind power as for coal-fired plant.**

Indicator	Tarong North[1]	Equivalent wind farm based on energy output[2]
Rated power	450 MW	1365 MW
Annual output	3587 GWh	3587 GWh
Total Australian jobyears for manufacture + installation	765 jobyears	5050 jobyears

Employment is created at various levels and has a strong rural and regional focus.

ii. Local non-manufacturing employment includes:

- Road-works
- Foundation laying
- Electrical transformer installation
- Crane works
- Cabling
- Project infrastructure
- Fencing

iii. Local / regional professional services include:

- Civil engineering
- Mechanical engineering
- Environmental engineering and specialist consultants
- Electrical engineering
- Legal and financial services

iv. Regional manufacturing

- An increased level of wind farm development would result in economies of scale sufficient to support greater levels of local (Australian) manufacture. This would in turn increase local content and the amount of employment generated for each wind farm.

- Currently Australian content is estimated at about 50 percent of total requirement with the balance largely coming from Danish and German manufacturers. Manufacturing in Australia includes tower construction and civil engineering, however, a new Vestas factory in Tasmania will extend manufacturing capability to nacelle assembly (the tower-top enclosure which houses the generator and gear box) and fibreglass components.

- With increased scale, it may be possible to source up to 90 percent of turbine manufacture within Australia in the near future. This would then comprise blade, nacelle and tower manufacture.

Factor	New typical 20 MW project	2002 indicator for scenarios
Direct Capital investment	A$36-40m	$1.8m /MW
Australian content (by value)	40-50%	50%
Australian capital investment	$16-18m	$0.9m /MW
Total direct jobyears for manufacture + installation	150-200	7.5 jobyears /MW
Total direct Australian jobyears for manufacture + installation	70-90	3.7 job year /MW (i.e. 50% Aust. Content)
Ongoing Australian O&M jobs	2-3	0.12 jobs /MW
Ongoing O&M expenditure	$360-400k /year	$18k /MW per year

Summary of direct employment from wind farms

Direct employment: Job creation is summarised in the table below. The investment and manufacturing created in wind power also levers an even greater level of indirect employment from the suppliers of service, materials and pre-manufacturing.

Indirect employment: Empirical evidence from the Danish market indicates that for every direct job, 4.1 indirect jobs are created (Sinclair Knight Merz, 2001). The European Wind Energy Association (EWEA) uses a more conservative multiplier of less than 3, with total direct and indirect employment estimated at 22 jobyears per megawatt. Thus for every 3.7 jobyears created for each megawatt installed, in the scenario of 50 percent local manufacture, at least 11 additional indirect jobyears are created.

The Australian Wind Energy Association (AusWEA) has proposed that stronger MRET targets would bring forward the economy-of-scale benchmark required to produce 90 percent of manufacturing locally. Thus the total 22 jobyears per megawatt created from direct and indirect employment, coupled with achieving 90 percent local manufacture, means that up to 9,375 jobs could be created in Australia with 5,000 MW installed by 2010. This is the installed capacity AusWEA believes wind would deliver under a 10 percent MRET (AusWEA, 2003).

b. Wind power provides considerable income to farmers.

- Windmills are synonymous with the Australian bush, and they now have the ability to do more than just pump water. It is expected that 50 percent of new renewable energy under a 10 percent MRET will be generated from wind power, which will itself form a significant drought-proof "crop", providing secure long-term income for farmers around Australia.

- If half the 10 percent target is met by wind power (which will be almost exclusively in rural areas) then the total income for rental of land from Australian farmers for wind farms would be in excess of $17,000,000 per annum from 2010. This is net income, and leases are typically in excess of 20 years long. (Assume 5,000 MW installed, $5,000 pa per 1.5 MW machine in 2003 dollars).

- Importantly, wind generation has a minimal impact on farming operations as typically less than one percent of farm land area is needed to accommodate the turbines and access roads. The 10 percent target will also make a much broader range of wind sites economical to build. This will see wind farms built in much more diverse country, including inland country that has been devastated by the drought.

- Wind power can be a boost to regional tourism. Surveys repeatedly indicate that wind farms can attract tourists. Current statistics show that more than 100,000 people per year are already being attracted to see wind farms in Australia.

c. A strong Australian wind energy sector means great potential for export.

It has been estimated that cumulative wind industry investment in the Australasian region will be US$115.3 billion by 2020 (EWEA, 2002). A number of other countries have established major manufacturing bases that supply local needs and generate significant export income.

d. Despite the strong employment and investment generation, the cost to end users of wind power is surprisingly small.

It is often assumed that any decision to encourage wind energy development would require a political choice between job creation and energy price. However, this choice would appear easier when it is shown that energy price effects are relatively modest.

According to McLennon, Magasanik Associates (2002), every 5 percent increase in the MRET is predicted to increase the average wholesale cost of electricity by only around 0.1 cent per kWh. This is smaller than many of the regular wholesale price movements within the National Electricity Market. The average Australian family could expect to pay only $1.20 per month more in electricity charges under a 10 percent MRET target.

3. International wind energy firms have selected Australia

Australian manufacturing capacity is contingent upon the level of industry development.

Numerous international companies have seen the considerable potential for wind energy in Australia. They have already established a presence in Australia and are investing significantly. They include NEG Micon (Denmark), Vestas (Denmark), General Electric Wind (USA), Garrad Hassan (UK), EHN (Spain), Nordex (Germany – pending), PB Power (USA), Babcock and Brown (UK), Wind Prospect (UK), Econnect (UK), Trustpower (NZ), Meridian Energy (NZ), Wind Farm Developments (NZ), and Suzlon Energy (India – pending).

One of the largest wind companies in the world, Vestas chose Australia to establish manufacturing facilities because it offers, "political and economic stability… a safe place for employees and their families… well developed financial and legal systems… a healthy industrial relations climate… skills, technological capabilities, components and materials availability... and well developed infrastructure" (Fourie, 2002).

4. But, Australia must make a clear commitment now to developing wind energy, or risk losing it's significant early-mover advantages.

Policy drivers will critically affect the future levels of investment and employment derived from wind energy. AusWEA has called for the MRET to be increased to 10 percent, with other organisations supporting an increase to at least 5 percent. These variations compared to 2 percent of projected generation in 2010 are considered in the report. *(Note, however, that the current MRET is not 2 percent, but has been set at 9,500 GWh. Based on recent predictions of energy consumption by 2010, this will translate into less than an additional 1 percent of renewable energy.)*

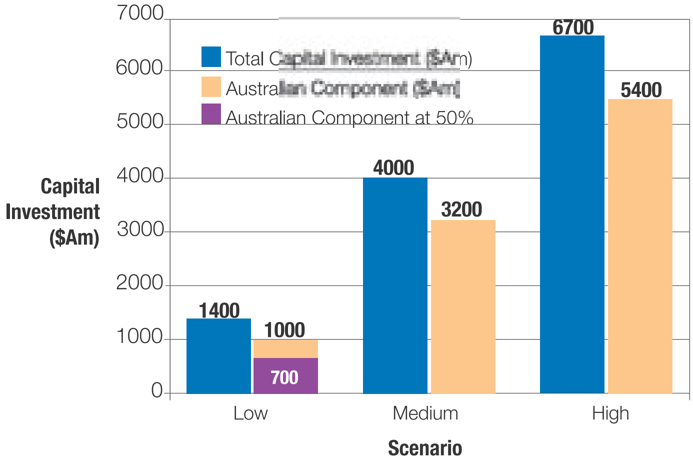
- An increase in the MRET from 2 percent to 5 percent by 2010 would result in additional direct capital investment in Australia of $2,200 million, additional operation and maintenance expenditure of $110 million, 1,500 additional Australian manufacturing and construction jobs, and 130 additional operation and maintenance jobs.

- Increasing the MRET from 2 percent to 10 percent would result in additional direct capital investment in Australia of $4,400 million, additional operation and maintenance expenditure of $210 million, 3,500 additional Australian manufacturing and construction jobs, and 280 additional operation and maintenance jobs. AusWEA estimates that the total investment (direct and indirect) resulting from a 10 percent MRET would be $10 billion.

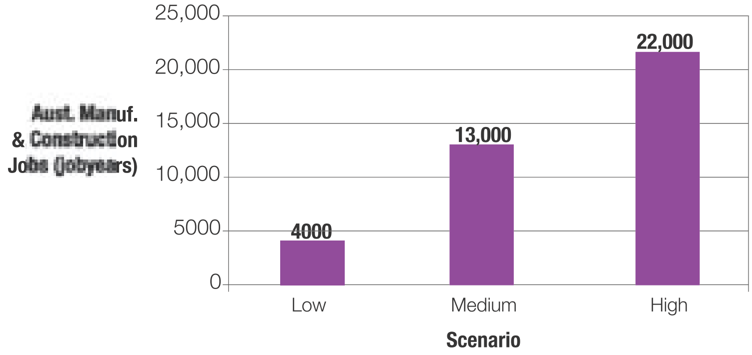
Future wind energy investment: The role of market creation

The major driver of the renewable energy industry in Australia, the Mandatory Renewable Energy Target (MRET), requires an additional 9,500 GWh of renewable electricity generation by 2010 compared to 1997 levels. The current MRET came into force on April 1st, 2001.
Calls to increase the MRET to an additional 5 percent or 10 percent of total generation over 1997 levels by 2010 have been widespread. There have also been calls that it be withdrawn in favour of emissions trading. In this report we consider low, moderate and high scenarios which approximate a 2 percent, 5 percent and 10 percent MRET. The effects on investment and employment are summarised in the following graphs and further expanded in the following tables:

Total Capital Investment



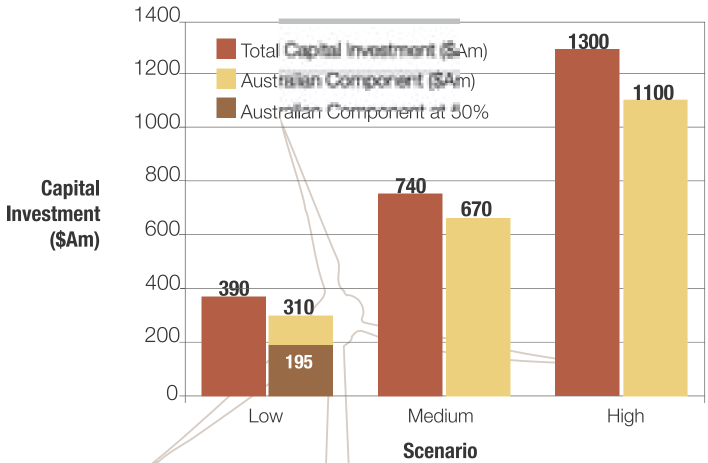
Australian Manufacturing and Construction Jobs



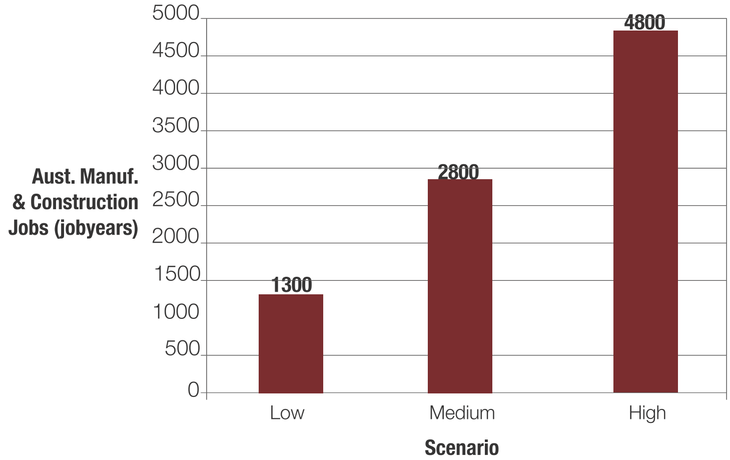
Estimated scenario outcomes for wind energy over the period 2002-2010[3]

Scenario	Installed capacity (MW)	Annual generation (GWh) in 2010	Total direct cap. investment (A$m)	Total Aust. component (A$m)	Direct Aust. manuf. & construction jobs (jobyears)	O&M expenditure (A$m)	Direct Aust. O&M jobyears
Low	1000	3200	1400	1000	4000	50	230
Medium	3000	9700	4000	3200	13000	160	840
High	5000	16,000	6700	5400	22000	260	1400

Annual Capital Investment



Manufacturing and Construction Jobs



Scenario outcomes for the size of the Australian wind industry in 2010[4]

Scenario	Annual Aust. installation (MW)	Annual generation (GWh)	Annual cap. investment (A$m)	Annual Aust. component (A$m)	Direct Aust. manuf. & construction jobs	Annual O&M expenditure (A$m)	Direct Aust. O&M jobs
Low	300	3200	390	310	1300	15	80
Medium	600	9700	740	670	2800	40	210
High	1100	16,000	1300	1100	4800	65	360

From MacGill and Watt (2003)

Conclusions

The Federal Government has already inspired 2,200 MW of projects (now in planning) in Australia through its landmark MRET legislation, though the current MRET target will only deliver half of this volume. Industry growth rates have averaged 118 percent per annum, which underlines the early success of this industry development measure.

Australia is already reaping significant employment and financial benefits from wind power, particularly in the rural and regional sector, through employment creation and inward investment.

This report indicates that stronger MRET market development can significantly increase the benefits to Australia, achieving domestic manufacture levels of 90 percent.

Analysis indicates that the cost to the end user of strong industry development up to a 10 percent MRET target is very modest compared to other price pressures on electricity, a difference that would not stand out against normal background market volatility.

1 Introduction

1.1 Wind Power: Global and Local

Wind power is now the fastest growing energy industry in the world with 10 year average annual growth rates estimated at over 24 percent. However, it is relatively new to the Australian power market, with strong growth having occurred only over the last four years.

In Australia, new renewable energy generation is predicted to increase over the next ten years, with the main drivers being the Mandatory Renewable Energy Target (MRET) and, to a lesser extent, Green Power (a national accreditation program that sets standards for renewable energy products offered by electricity suppliers to households and businesses). A significant amount of this generation is expected to be provided by wind farms, and widespread deployment will most probably have the greatest impact in rural and regional areas.

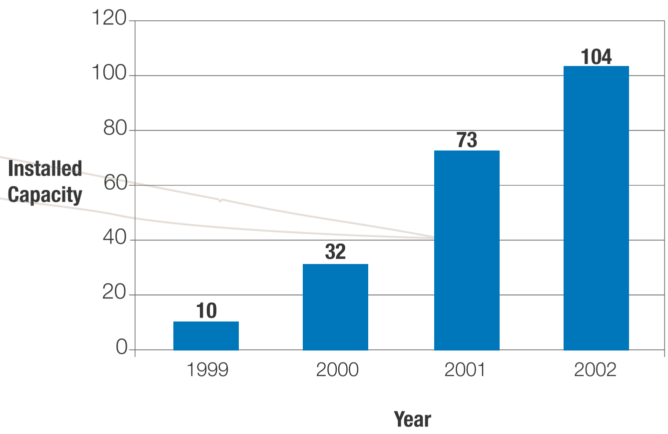
Wind farms require open, unobstructed areas with reasonably constant non-turbulent airflow and medium to high wind speeds. They are therefore located outside urban areas. Australian wind regimes offer exceptional potential for wind farms. In Australia the most promising winds are found along the southern coastline of Western Australia, South Australia, Victoria, many parts of Tasmania, inland along the Great Dividing Range of NSW (Figure 1), and on the tablelands of Queensland.

This report reviews the literature on wind farms' potential employment and financial benefits in Australia, with a focus on rural and regional areas. It concludes that wind farms would provide significant employment and financial benefits to these areas.

1.2 The Growth of Wind Generation in Australia

The wind energy industry in Australia is relatively new, but developing rapidly. Globally, wind power has been growing at an average rate of 22.4 percent per annum between 1990 and 2000 (IEA, 2002), and almost 40 percent annually over the last five years (EWEA, 2002). In Australia the installed capacity of turbines greater than 25 kW increased by an average of 118 percent per year between 1999 and 2002 (Figure 1). However AusWEA has acknowledged that this current growth rate can not be sustained, even in the short term without an increase in the MRET.

Figure 1 Installed wind capacity in Australia.



1.3 Projects in Planning

Table 1 presents currently proposed wind power capacity in Australia which amounts to over 2,200 MW. The majority of these projects are on the southern coast of South Australia and Victoria, in Tasmania with the exceptions being Challicum Hills near Ararat in Victoria and the extension of the Windy Hill project in North Queensland (AusWEA, 2003). There is also growing interest in the Western Slopes and Northern Tablelands regions of NSW where a number of wind monitoring towers have been erected.

Table 1 Current and proposed wind power capacity in Australia

State	Installed MW	Approved or under construction (MW)	Proposed MW	Total MW
SA	0.15	270.3	656	926.4
Vic	39.26	232.5	260.5	532.3
Tas	11.33	129.6	300	440.9
NSW	16.62	0	50.3	66.9
WA	24.73	104	120.8	249.6
NT	0.08	0	0	0.08
Qld	12.45	0	12	24.5
Total	104.62	736.4	1399.6	2240.6

Source: AusWEA (2003)

2 Rural Development and Wind Power Development

2.1 The Regional Imperative

Many parts of regional and rural Australia, especially those further from regional centres, are severely strained compared to metropolitan areas in terms of employment, income and access to services. These communities have borne the brunt of broader economic reform as services are progressively withdrawn.

Traditionally, the electricity industry has been a significant source of regional employment. However, it is currently undergoing a process of disaggregation and restructuring intended to increase market competition and therefore economic efficiency. Employment in the electricity industry fell by half, from 67,090 jobs in 1989-90 to 33,438 in 2000-01 (ABS, 2002). Simultaneously employment in the NSW coal industry has dropped by 40 percent, from 16,694 jobs in 1990 to around 10,000 in 1999 (SEDA, 1999). Significant numbers of jobs lost were in regional areas, and all occurred while electricity output steadily increased. Decreased coal mining labour intensity and consequent job losses are not restricted to Australia; a US study predicted ongoing job losses of 36 percent between 1998 and 2008 (REPP, 2001).

Employment in the electricity industry fell by half from 1989-90 to 2000-01. Simultaneously employment in the NSW coal industry has dropped by 40 percent, from 1990 to 1999. Significant numbers of jobs were lost in regional areas, and all occurred while electricity output steadily increased. Alternativly, wind power development would focus employment and development potential in these areas.

As outlined in Section 8 below, wind farms provide significantly more employment than coal-fired power stations for the same amount of electricity generated, with only a negligible price increase to the end user. Because a significant proportion of total wind investment expenditure must be spent in or near the rural and regional sites, wind power development would further focus this employment and development potential in these areas.

2.2 The Wind Power/Rural Australia Overlap

Renewable energy, while growing rapidly, still supplies only a small proportion of demand in Australia -- approximately 10 percent. Most is from old hydroelectric facilities in Tasmania and the Snowy Mountains. However, wind is clearly an industry capable of generating significant social and economic benefits, especially in rural and regional areas. This view was supported by the recent Council of Australian Governments' (CoAG) Energy Market Review which stated that:

"The Panel considers that regional Australia stands to benefit from a greater uptake of renewable generation technologies. …. Alternative and renewable generation technologies, subject to the viability of cost effective greenhouse gas reduction strategies, are likely to have a particular benefit for regional Australia. Resource and land availability considerations mean that many such technologies are likely to be regionally based and bring economic benefit to regional areas." (Parer, 2002).

A recent report by Allen Consulting modelled the impact on NSW of extending the MRET from the present target by requiring an additional 9,500 GWh of renewable energy between 2005 and 2014. This would require an additional 19,000 GWh over 1997 levels, which is roughly equivalent to a 5 percent MRET. When combined with a fund used to promote investment in renewable energy generation and demand management[5], they found that the Gross State Product would increase by an average of $500 million, or around 0.17 percent, each year between 2005 and 2020. In addition, employment would increase by an average of about 4,100 full and part time jobs, or 0.12 percent per year over the same time period. Of these, 3,060 jobs would be generated outside the fossil fuel or renewable energy industries (ACG, 2003). Note that a proportion of these benefits would accrue to other states or territories if they established an equivalent fund or similar measures.

3 Australian Wind farms: Employment and investment

3.1 Employment and Investment

A number of authors have published estimates for the financial and employment outcomes of renewable energy (Redding, 2002; Roy and Mawer, 2002; DWIA, 2002; MacGill et al., 2002; BTM, 2001; REPP, 2001; SKM, 2001; AWEA, 2000; ACIL, 2000; SEDA, 1999). However, because of its rapid growth the industry is very dynamic; these data are constantly changing.

One of the largest wind companies in the world, Vestas has stated that it has chosen to establish manufacturing here because Australia offers, "political and economic stability... a safe place for employees and their families... well developed financial and legal systems... a healthy industrial relations climate... skills, technological capabilities, components and materials availability... and a well developed infrastructure" (Fourie, 2002)

A recent detailed analysis by MacGill and Watt (2003), which draws upon a number of recent Australian and international analyses and Australian case studies, arrived at reasonable estimates for the financial and employment outcomes of Australian wind farms. The authors also derived estimates for how these figures would change over time until 2010 due to a range of factors including economies of scale, increased turbine sizes, improved turbine technology, and local manufacturing. These indicators are shown in Table 2.

Table 2 Chosen indicators and their evolution over 2002 to 2010

Factor	New typical 20 MW project	2002 indicator for scenarios	Indicator change to 2010
Direct capital investment	A$36-40m	$1.8m /MW	Reduction at 5% annually to $1.2m/MW in 2010 (2001 dollars) – an overall 33% reduction.[6]
Australian content (by value)	40-50%	50%	Linear increase to 90% by 2008 then steady.
Total direct Australian capital investment	$16-18m	$0.9m /MW	Reflects falling MW costs yet increasing Australian content giving $1.1m/MW for installations in 2010 (2001 dollars)
Total direct jobyears for manufacture + installation	150-200	7.5 jobyears /MW	Reduced at 5% annually as for capital costs to 5 jobyears/MW in 2010 – an overall 33% reduction.
Total Australian jobyears for manufacture + installation	70-90	3.7 jobyear /MW (ie. 50% Aust. Content)	Reflects falling total jobyears yet increasing Australian content giving 4.5 jobyears /MW for installations in 2010
Ongoing Australian O&M jobs	2-3	0.12 jobs /MW	Falls at 9% annually to 0.06 jobs/MW for installations in 2010 – an overall 50% reduction.
Ongoing O&M expenditure	$360-400k /year	$18k /MW per year	Falls with falling capital costs to $12k /MW for installations in 2010.

They are used in this report because of the wide variety of separate analyses used to derive them, because they are the most recent available, and because the calculations and assumptions used to derive them are clearly stated and transparent. See Appendix 1 for a detailed explanation of how these indicators were developed. Note that unlike the employment indicators used in Windforce 12, they include only direct employment, not indirect.

The investment and manufacturing required for wind power derives a significant level of indirect employment for the suppliers of service, materials and pre-manufacturing. Empirical evidence from the Danish market indicates that for every direct job, 4.1 indirect jobs are created (Sinclair Knight Merz, 2001). The EWEA uses a more conservative multiplier of less than 3, with total direct and indirect employment estimated at 22 jobyears per MW. Thus the 3.7 jobyears/MW generated by 50 percent local manufacture may be estimated to create between 11 and 15 total jobs in Australia per megawatt installed.

AusWEA proposes that stronger MRET targets would create conditions needed to bring about 90 percent local manufacture. Under the "high" scenario of 5000 MW installed by 2010, the total 22 jobyears/MW created from direct and indirect employment, coupled with achieving 90 percent local manufacture, would translate into 9,375 jobs created in Australia (AusWEA, 2003).

4 Breakdown of Employment in Wind Power

4.1 Local (Non-Manufacturing) Employment

4.1.1 Rural and Regional Focus

In order to maximise local benefits from projects, wind farm developers commonly source as many goods and services as possible locally.

Local employment is generated through construction of roadworks, foundations, electrical transformers and cabling, viewing areas, and other basic infrastructure such as fencing. For example, at the Windy Hill wind farm, 9 of the 17 contracting firms that worked on the project were based in Cairns or the Atherton Tablelands area; the turbines are monitored and maintained by 3 people local to the Ravenshoe area. The Codrington wind farm achieved 40 percent local content, injecting more than $8 million into the regional economy during the development and construction stages (PHY, 2001).

There is also the need for professional services which may be available regionally. These include environmental, civil, electrical and mechanical engineering services as well as legal and financial services.

4.2 Manufacturing

4.2.1 Regional Manufacturing

An increased level of wind farm development would result in economies of scale sufficient to support local manufacture. This would in turn increase local content and employment generated for each wind farm. In addition, local manufacture would reduce the risk associated with exposure to exchange rate fluctuations. Three wind turbine manufacturing facilities have been proposed to date:

- **Tasmania:** In response to an unconditional order for 128 megawatts of wind turbines by Hydro Tasmania, Vestas have committed to assembly of turbine nacelles and manufacture of fibreglass components in Tasmania (HT, 2002). This will create 70 direct jobs now, with the possibility of significantly more in the future if plans for a blade manufacturing plant are realised.

NEG Micon is committed to a blade manufacturing plant in Portland, on the basis that the Portland Wind Energy Project proceeds. NEG will consider the assembly and manufacture of nacelle and other elements locally. This is all dependant on the security of the wind power market in Australia.

- **Victoria:** The NEG Micon blade manufacturing plant - subject to the Portland wind energy project proceeding - will employ an initial workforce of approximately 60, with potential to scale up substantially from there depending on the growth of the Australian wind market.

Separately, NEG has engaged Kepple Prince Engineering of Portland to manufacture towers, and they have already taken on 73 workers to do so. If the market continues to develop, NEG will consider the assembly and manufacture of nacelle and other elements locally. This is all dependent on the security of the wind power market in Australia. Local blade manufacture will increase local content by value to over 60 percent for wind farm projects.

- **Queensland:** Walkers Engineering of Maryborough in QLD, together with Downer Energy Systems, both divisions of Downer EDI, have joined with R.F. Industries to form Notus Power Partners. Together with Systems AG of Germany, Notus Power Partners has formed a 50:50 joint venture called Notus Energy Pty Ltd, which will produce fully integrated wind energy systems. The new company's headquarters will be in Maryborough, where it will manufacture wind turbines and generate an estimated 35 jobs at Maryborough in the first year (2003-2004), for a total of approximately 70 jobs over the first three years (NE, 2002).

It has been estimated that cumulative investment in the Australasian region will be US$115.3 billion by 2020 (EWEA,2002). Australia could miss out on the sustained global and regional wind energy manufacturing expansion if government does not support local industry development to ensure international competitiveness.

4.2.1 International Export

It has been estimated that cumulative investment in the Australasian region will be US$115.3 billion by 2020 (EWEA, 2002). However it cannot be taken for granted that local manufacturing capacity will also be established to meet this demand. Australia could miss out on the sustained global and regional wind energy manufacturing expansion if government does not support local industry development to ensure international competitiveness.

Nevertheless the following international companies have already established a presence in Australia and are investing significantly, including Danish manufacturers NEG Micon and Vestas, General Electric Wind (USA), Garrad Hassan (UK) and EHN (Spain).

In a number of other countries, major manufacturing bases have been established which supply local needs and generate significant export income. In Germany an estimated 35,000 people are currently employed both directly and indirectly by the industry. Sales in the sector were expected to have reached US$3 billion during 2001. In Denmark the industry now provides jobs for 20,000 people and a further 8,000 in component supply and installation work around the world. Annual output, mainly for export, has increased almost tenfold from 368 MW in 1994 to 3,000 MW in 2001, a turnover of US$2.6 billion. The Spanish province of Galicia is aiming to ensure that 70 percent of $2.6 billion in expected provincial wind power investment stays within its borders. This would create more than 2,000 direct and 3,000 indirect jobs for the province (EWEA, 2002).

Vestas have stated that the following criteria led to their decision to establish local manufacture in Australia:

1. *A high degree of confidence that the return on investment in local manufacturing facilities will meet the required Vestas hurdle rates and payback period;*
2. *Political and economic stability;*
3. *Safe environment for their employees and their families to live and work;*
4. *Well developed financial and legal systems and processes;*
5. *A healthy industrial relations climate;*
6. *Required skills, technological capacities, components and materials are all readily available;*
7. *Well developed infrastructure and readily available and affordable essential services (Fourie, 2002).*

4.3 Income for Farmers

4.3.1 Farms and Wind Farms

Wind farms occupy only a very small proportion of land (less than 1 percent) and so are compatible with dual usage alongside agricultural activities such as cropping and grazing. Lease payments made to farmers who host wind turbines provide additional income with almost no effect on ongoing agricultural revenue.

4.3.2 Lease Payments

Landowner payments in the US are typically about US$2,000 per 750 kW turbine per year. However, depending on the type of financing arrangement (eg. up-front lump sum, ongoing flat fee, payment as percentage of turbine output), payments range widely from US$300 to US$3,000 per MW (UCS, 2002; OWS, 2001; Windistry, 2002).

In Australia, with turbine sizes increasing to over one megawatt, landowners are generally offered a percentage of the revenue generated by the turbines -- typically 1.5 to 2 percent. For larger machines this can equate to around $5,000 annually per turbine over the 20 to 25 year life of the wind farm. In some cases developers have reportedly offered over $6,000 annually per machine just to win a site against competing developers. However, it is important to note that setting such high landowner expectations on rent can impact the financial viability of projects for developers.

4.4 Tourism Generated by Wind Farms

Over the last 20 years tourism has developed into an important source of income for many rural and regional areas. While it is difficult to quantify the impacts of a wind farm on tourism, they do appear to act as tourist destinations that bring dollars into the area.

A survey conducted by Auspoll in Victoria during February, 2002 found that 70 percent of those surveyed thought wind farms to be an interesting landmark that would help create tourism. Furthermore, 36 percent of those surveyed said they would be more likely to visit the coast if there were wind farms in the area, 55 per cent indicated that it would make no difference, while only 8 per cent said they would be less likely to visit the area (PHY, 2002).

These results are similar to those found in a survey conducted in Argyll, Scotland, where it was found that 80 percent of tourists would be interested in visiting a wind farm if it were open to the public with a visitor centre, with 54 percent being very interested (MORI, 2002).

Codrington wind farm currently attracts 50,000 visitors per year. A tour company has been specifically set up to meet tourism demands, and site tours are run up to six times a week. West Coal Rail is now offering day tours of the wind farm.

4.4.1 The Effects of Wind Tourism : Examples

The following summarises some of the impacts that wind farms have had on tourism in Australia.

- The Salmon Beach (recently closed) and Ten Mile Lagoon wind farms have been included in the Esperance Tourist Bureau information and visitor guides and are visited by about 50,000 people each year (SKM, 2001). Road counters to the Ten Mile Lagoon wind farm were measuring 80 cars per day.
- A Wind Discovery Centre is planned for the Albany wind farm. A strategic assessment project has been announced that will investigate design options for a world class visitor centre that would attract additional tourists to the Albany region.
- The Crookwell wind farm open day was attended by 400-500 people. Since then tourists have travelled to the wind farm both as individuals and interest groups.
- Codrington wind farm currently attracts 50,000 visitors per year. A tour company has been specifically set up to meet tourism demands, and site tours are run up to six times a week. West Coal Rail are now offering day tours of the wind farm (WCR, 2003).
- The Windy Hill wind farm on the Atherton Tablelands was visited by approximately 30,000 cars in the first three months of operation, and a local company includes the wind farm in its tour (AusWEA, 2002).
- Following the success of the public open days that saw 7,000 people visit the Woolnorth wind farm, Hydro Tasmania has contracted tour operator Woolnorth Tours to conduct one hour, half-day and full day tours of the wind farm (HT, 2002a).
- In Britain, approximately 350,000 tourists visited the Delabole wind farm between 1992 and 1999 SKM (2001).

5 Comparison of Wind Farm and Coal-Fired Generation: Employment and financial indicators

5.1 The Effect of Job Displacement – Installed Capacity

The effect of increased wind power deployment on displacement of jobs from the fossil fuel industry must be considered in any analysis of wind power's contribution to the Australian economy. These types of jobs are typically in rural areas and can be a significant source of primary industry income.

It is clear that a shift in favour of wind energy generation over fossil fuel sources like coal will result in a significant net job gain to the Australian energy sector.

The following compares the 2002 wind farm indicators used above to a case study of the Tarong North coal-fired power station (MacGill et al., 2002), in terms of their employment and financial benefits. The Tarong North plant is due to be commissioned in 2003 and so is indicative of the types of coal-fired power stations likely to be built and/or displaced by increased development of wind power.

In all cases, the wind farm indicators correspond to more investment and employment than those of Tarong North Power Station. The exception is for operation and maintenance (O&M) jobs, of which Tarong North provides slightly more than the wind option.

5.2 The Effect of Job Displacement – Produced Energy

The advantage of wind farms in generating employment and financial benefits becomes still more apparent when they are compared on the basis of electricity generated.

Wind farms and coal-fired power stations have very different capacity factors. This is because they do not run at full power all the time; rather they operate at different average fractions of full power. Because wind farms generally operate at a lower capacity factor than coal plants, more megawatts of wind farms are required to generate the same amount of electricity. For example, assuming a capacity factor of 30 percent for an average wind farm and 91 percent for Tarong North respectively (Tarong North capacity factor from MacGill et al, 2002), 1,365 MW of wind power would be required to generate the same amount of electricity as Tarong North at 450 MW.

This translates into 5,050 Australian jobyears for manufacture and installation for the 1,365 MW wind farm and 756 Australian jobyears for Tarong North (Table 4). That is, there are 6.6 times more manufacture and installation jobs created by wind power than by coal-fired generation.

Tarong North is a supercritical power station and its capacity factor may be higher than the Australian average. However, even use of a capacity factor as low as 70 percent would result in an equivalent wind farm being 1,050 MW. This would equate to 3,885

Table 3 Comparison of 2002 wind farm indicators with Tarong North (coal) Power Station

Indicator	2002 indicator for scenarios[7]	Tarong North[8]
Capital investment	$1.8m/MW	$1.3million/MW
Australian content (by value)	50%	26%
Regional content (by value)	estimated 29%[9]	estimated 3%
Direct Australian capital investment	$0.9m/MW	$0.33m/MW
Total direct Australian jobyears for manufacture + installation	3.7 job year/MW (i.e. 50% Aust. Content)	1.7 job year/MW
Ongoing Australian O&M jobs	37 jobyears/TWh	42 jobyears/TWh

Australian jobyears for wind power manufacture and installation, still considerably greater than that provided by a coal-fired power station.

Although Tarong North does provide slightly more O&M jobs than an average wind farm per TWh (terawatt-hour; one terawatt equals 1,000,000 megawatts), this would make little difference to the total jobs created. For example, assume that the above-cited 1,365 MW wind farm and 450 MW Tarong North coal plant operated for 20 years, producing 72.48 TWh each, with a constant level of O&M employment. The difference in O&M employment would be only 360 jobyears. Total jobs (including O&M) created by wind would be 2.0 times higher than the equivalent coal plant. In practice the difference in O&M employment would be even less than that just cited because O&M jobs for both types of plant will likely decrease over time as technology advances.

Table 4 Comparison of Australian manufacture and installation employment generated by Tarong North (coal) Power Station and an average wind farm

Indicator	Tarong North[12]	Equivalent wind farm based on Energy output[13]
Rated power	450 MW	1365 MW
Annual output	3587 GWh	3587 GWh
Total Australian jobyears for manufacture + installation	765 jobyears	5050 jobyears

It is clear that a shift in favour of wind energy generation over fossil fuel sources like coal will result in a significant net job gain to the Australian energy sector. The obvious question then becomes, at what financial cost?

6 Decision Making: The Cost of Wind Industry Development

The foregoing material has demonstrated the strong link between wind industry development and rural investment and employment creation. Yet in the current Australian market structure wind power is more expensive than coal-fired generation. Price, however, is a dynamic variable and the introduction of carbon trading may affect this difference in future.

The wind power industry in Australia is relatively immature, and the costs and employment generated for a given output are expected to change with time. Larger wind farms will result in economies of scale, which combined with the effects of experience, improved technology, and local manufacture, will reduce costs. However, increased use of sites that are more expensive because they have inferior wind regimes, more difficult access and higher transmission costs will affect these cost reductions.

Given that the wind resource (fuel) is free of costs such as government resource taxes, the extra cost of wind power translates directly into additional wages and therefore employment. This combined with the higher Australian/regional content compared to fossil fuel generation indicates that wind power has significant employment and financial benefits for rural and regional Australia.

Until environmental externalities of fossil fuel generation are fully internalised in its price (for example internalizing the cost of the greenhouse gas carbon dioxide through carbon trading), it is unlikely that the cost of wind power in Australia will be less than that of fossil fuel power in the foreseeable future. Thus a political decision must be made between job creation and energy price. However, the price penalty under an increased MRET scenario might not be as significant as some believe.

According to MMA (2002), every 5 percent increase in the MRET is predicted to increase the average wholesale cost of electricity by only around 0.1 cent per kWh, which is smaller than many of the regular wholesale price movements within the National Electricity Market. Looking at the delivered cost of electricity, at current market prices of approximately 12.5 cents per kWh residential and 6.2 cents industrial, the effect of a 10 percent MRET represents increases of 1.7 percent and 3.3 percent respectively. Put another way, the average Australian family can expect to pay only $1.20 per month more in electricity charges for a 10 percent MRET. Even with this modest increase, Australian electricity prices would remain amongst the lowest in the industrialized world.

The average Australian family can expect to pay only $1.20 per month more in electricity charges for a 10 percent MRET. Even with this modest increase, Australian electricity prices would remain amongst the lowest in the industrialized world.

7 Future Trends: Renewable Market Drivers

7.1 The Mandatory Renewable Energy Target

The major driver of the renewable energy industry in Australia is the Federal Mandatory Renewable Energy Target (MRET). It requires an additional 9,500 GWh of renewable electricity generation by 2010 compared to 1997 levels, and came into force on April 1st, 2001.

The significance of this scheme lies in its ability to promote industry development by providing long term certainty for investors. Though the framework is generally considered to function effectively, concerns have arisen about the effectiveness of the target. The original recommendation was for additional renewable energy generation of 2 percent, but this was changed to a flat target of 9,500 GWh. Because of growth in overall electricity demand, this flat target may only just maintain existing market share of renewable energy generation (BCSE, 2003), or according to some reports could even result in the share dropping to lower levels than in 1997 (Roy and Mawer, 2002).

The major driver of the renewable energy industry in Australia is the 2 percent Federal Mandatory Renewable Energy Target (MRET), which was changed to a flat target of 9,500 GWh. However, because of growth in overall electricity demand, this flat target may only just maintain existing market share of renewable energy generation, or could even result in the share dropping to lower levels than in 1997.

7.2 Proposed Changes to the Target

With the MRET scheme due for review in early 2003 there have been widespread calls for reintroduction of an indexed target, and for that target to represent an increase to either 5 percent or 10 percent over 1997 levels. Such increases are thought to be necessary to have a significant long term impact on reducing greenhouse gas emission (GHG) emissions, to capture a share in any future growth in overall electricity demand and to develop the industry to a level where it will not only service Australia but also provide significant export income.

Despite the obvious success of the MRET in promoting growth of the renewable energy industry, the Energy Market Review report to the Council of Australian Governments (CoAG) suggested that the legislation be withdrawn. CoAG believed that the number of different regulatory requirements was too complex. Instead, the report recommended that all requirements, along with the MRET, be terminated in favour of a comprehensive emissions trading scheme – even though this scheme lacks any specific mechanisms for continued development of the renewable energy industry.

7.3 The Importance of Wind Power in the MRET

Wind power is expected to make up a significant proportion of both the existing MRET and any increase. A number of projections, including those of AusWEA, estimate that at least one quarter of the existing MRET target will be met by wind generation, as will about one half of any additional increases up to 10 percent.

As outlined above, wind farms generate employment in rural and regional areas during manufacture, construction and operation. They also generate income through lease payments to landholders, and through tourism. The following section outlines estimates of the total amount of employment generated by wind farms in Australia. These figures allow an estimate of the employment and financial benefits of the wind capacity predicted to be built in response to a 2 percent, 5 percent or 10 percent MRET.

8 The Effects of Increased MRET Targets: Wind Development

8.1 Energy Capacity Created by Various Targets

A number of separate analyses have been performed to calculate the contribution of wind power to the current 9,500 GWh MRET target.(Generally estimated as less than 1% of anticipated generation in 2010). Based on a total MRET requirement of 9,500 GWh and a projected Green Power requirement of 1,000 GWh, Redding (2002) estimated a total contribution by wind of 3,300 GWh by 2010. This is in close agreement to the MMA (2002) estimate of 3,050 GWh, and the AEA (2001) estimate of 2,950 GW, both excluding Green Power. Assuming a 30 percent capacity factor, these equate to an installed capacity of 1,255 MW, 1,160 MW and 1,120 MW respectively.

Estimates of the effect of increasing the current MRET to 5 percent and 10 percent have also been performed. However, care must be exercised when interpreting these results because some analyses are based on a percentage increase relative to 1997 levels by 2010, and some are based on a percentage of the projected total generation in 2010.

AusWEA's analysis, based on an increase relative to 1997 levels, indicated that a 5 percent target would lead to 7,210 GWh of wind generation which, assuming a 30 percent capacity factor, would equate to around 2,470 MW of wind generation (this assumed wind generation would take 50 percent of the market share over and above the 9,500 GWh target). MMA (2002) calculated that a 5 percent MRET based on an increase relative to 1997 levels would require 18,708 GWh of new renewable energy generation, whereas that based on 5 percent of projected generation by 2010 would require only 16,610 GWh. Based on the latter result, they estimated that 9,470 GWh of wind generation would be required by 2010, which equates to 3,600 MW assuming a 30 percent capacity factor.

AusWEA also estimated the effect of a 10 percent MRET, again based on an increase relative to 1997 levels, and found that 30,150 GWh of renewable generation would be required (close to the Business Council for Sustainable Energy [2003] estimate of 33,800GWh). They assumed a wind contribution of 26 percent for the first 9,500 GWh and 50 percent of the remainder, and an average capacity factor of 29 percent (the decrease from 30 percent assumes the use of more of the weaker wind resource). They conclude that 5,037 MW of wind generation would be required.

MMA (2002) calculated that a 10 percent MRET based on an increase relative to 1997 levels would require 29,795 GWh of new renewable energy generation, whereas that based on 10 percent of projected 2010 generation would require only 23,435 GWh. Again based on the latter result, they estimated that 16,046 GWh of wind generation would be required by 2010, which equates to 6,320 MW assuming a 29 percent capacity factor.

For both the 5 percent and 10 percent outcomes, the MMA (2002) estimates for installed capacity are greater than those of AusWEA because they assumed significantly greater input from wind. Namely, MMA assumed 57 percent and 68 percent of new renewable generation for a 5 percent and 10 percent MRET respectively, whereas AusWEA assumed 38 percent and 42 percent respectively. It would therefore appear that AusWEA's estimates are more conservative.

9 The Effects of Increased MRET Targets: Employed and Investment

9.1 Scenarios for Growth

Based on the indicators given in Table 2, MacGill and Watt (2003) have estimated the impact of three wind development scenarios on employment and investment in Australia up to 2010. The three scenarios -- low, medium and high -- assume 1,000 MW, 3,000 MW, and 5,000 MW respectively of installed plant by 2010. These are similar to the amounts of wind power proposed above in response to a 2 percent, 5 percent, and 10 percent MRET respectively. Note that their calculations assume a 37 percent capacity factor which may be a little high. Although new wind farms such as those soon to be built at Portland have an estimated capacity factor of

34 percent (SKM, 2001), this is for a very good wind regime. It is expected that as such exceptional sites are exhausted, average capacity factors will settle to more consistent levels. As above, AusWEA's estimates for the current and 10 percent MRET capacity factors are 30 percent and 29 percent respectively. A lower capacity factor would increase both the installed MW capacity and the employment and financial outcomes relative to a given amount of electricity generated. See Tables 5 to 9.

9.2 Investment and Jobs by Sector

MacGill and Watt (2003) note that "These outcomes need to be treated with considerable caution given the difficulties and approximations required in their estimation. Nevertheless, they suggest that the Australian wind industry has the potential to deliver significant investment and employment over the coming decade".

Increasing the installed capacity from 1,000 MW to 5,000 MW by 2010 (similar to expanding the MRET to 10 percent) would result in additional direct capital investment in Australia of $4,400 million, additional operation and maintenance expenditure of $210 million, 3,500 additional direct Australian manufacturing and construction jobs, and 280 additional operation and maintenance jobs (see Table 9).

According to these figures, an increase in installed capacity from 1,000 MW to 3,000 MW would, by 2010, result in additional direct capital investment in Australia of $2,200 million, additional operation and maintenance expenditure of $110 million, 1,500 additional Australian manufacturing and construction jobs, and 130 additional operation and maintenance jobs (see Table 8). Increasing the installed capacity from 1,000 MW to 5,000 MW would result in additional capital investment in Australia of $4,400 million, additional operation and maintenance expenditure of $210 million, 3,500 additional Australian manufacturing and construction jobs, and 280 additional operation and maintenance jobs (see Table 9).

Table 5 Estimated scenario outcomes for wind energy over the period 2002-2010[14]

Scenario	Installed capacity (MW)	Annual generation (GWh) in 2010	Total direct capital investment (A$m)	Total Aust. component (A$m)	Direct Aust. manuf. & construction jobs (jobyears)	O&M expenditure (A$m)	Direct Aust. O&M job years
Low	1000	3200	1400	1000	4000	50	230
Medium	3000	9700	4000	3200	13000	160	840
-High	5000	16,000	6700	5400	22000	260	1400

From MacGill and Watt (2003)

Figure 2: Installed Capacity

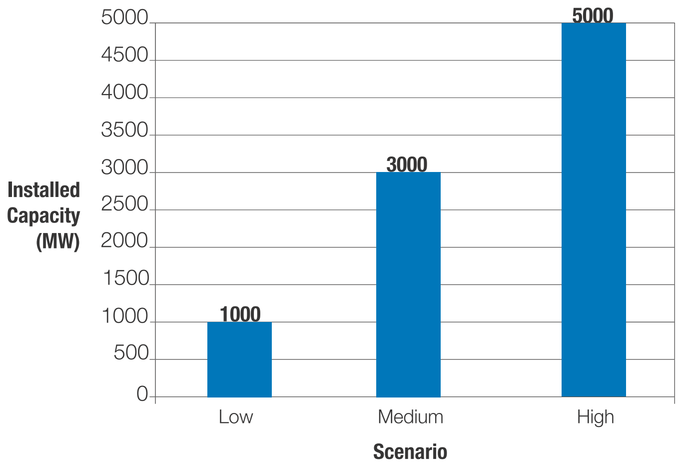


Figure 3: Annual Energy Production

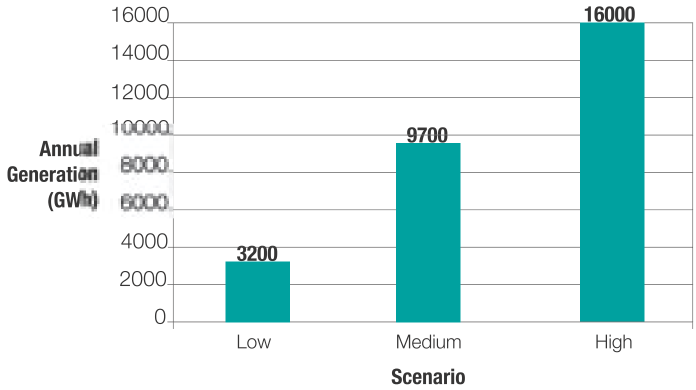


Figure 4: Total Capital Investment

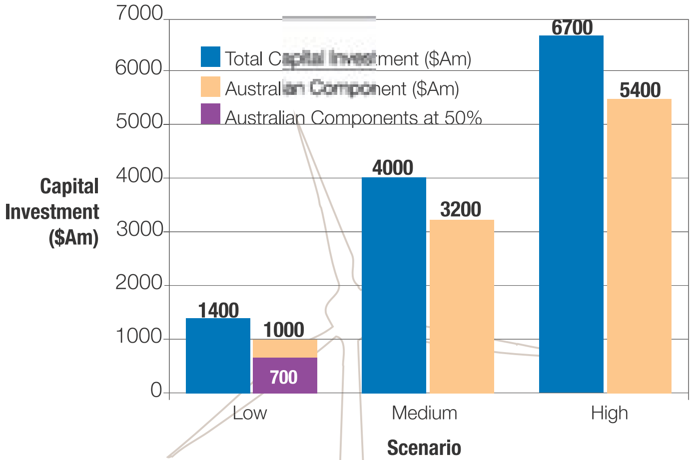


Figure 5: Australian Manufacturing and Construction Jobs

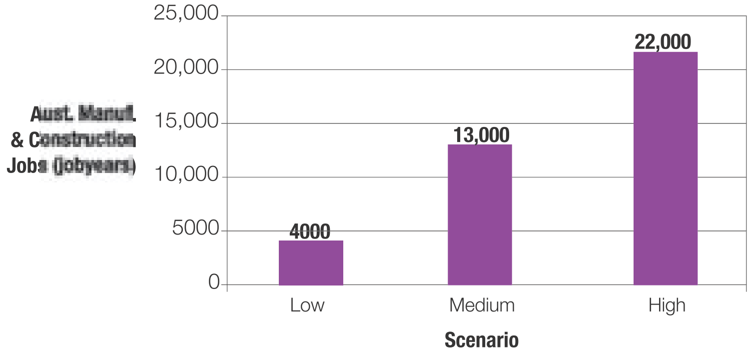


Figure 6: O&M Expenditure

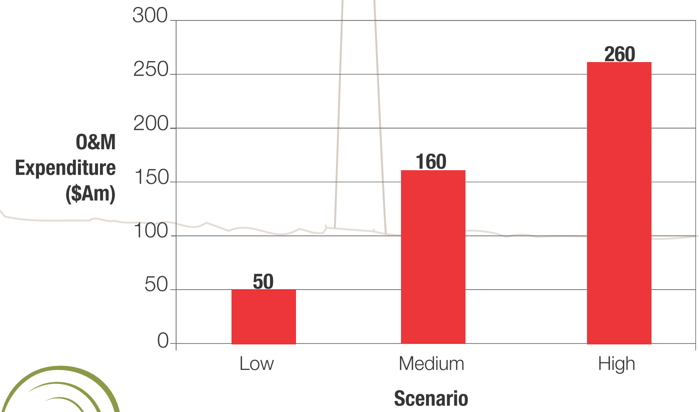


Figure 7: Australian O&M Jobyears

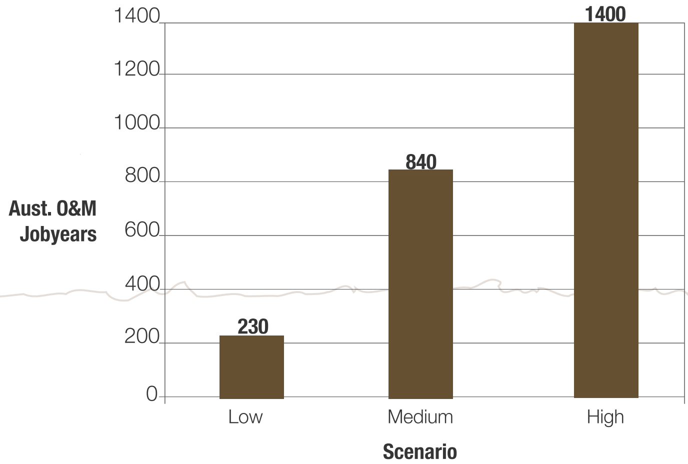


Table 6 Scenario outcomes for the size of the Australian wind industry in 2010[15]

Scenario	Annual Aust. installations (MW)	Annual generation (GWh)	Annual cap. investment (A$m)	Annual Aust. component (A$m)	Direct Aust. manuf. & construction jobs	Annual O&M expenditure (A$m)	Direct Aust. O&M jobs
Low	300	3200	390	310	1300	15	80
Medium	600	9700	740	670	2800	40	210
High	1100	16,000	1300	1100	4800	65	360

From MacGill and Watt (2003)

Figure 8: Annual Installed Capacity

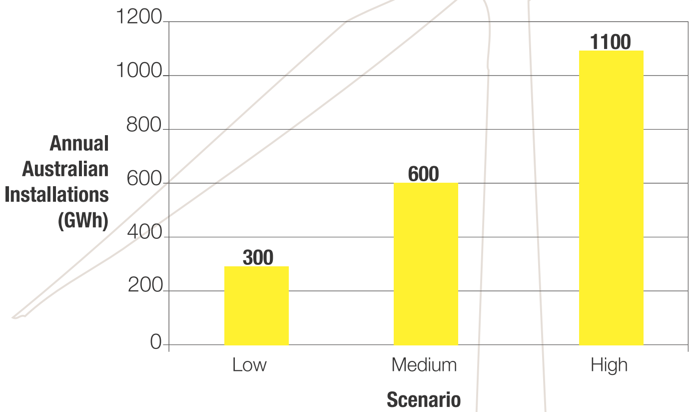


Figure 9: Annual Energy Production

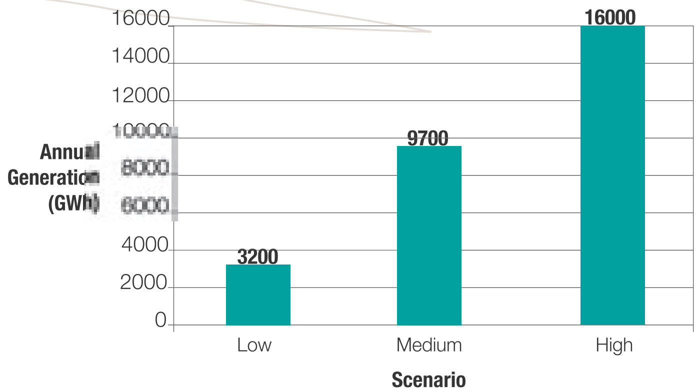


Figure 10: Annual Capital Investment

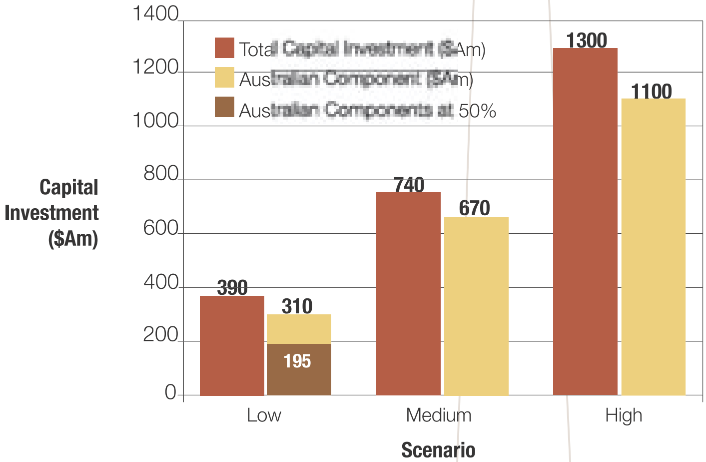


Figure 11: Manufacturing and Construction Jobs

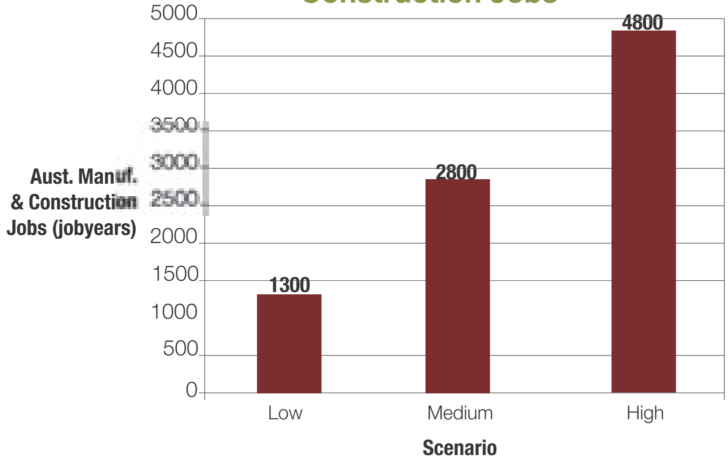


Figure 12: Annual Operation and Maintenance Expenditure

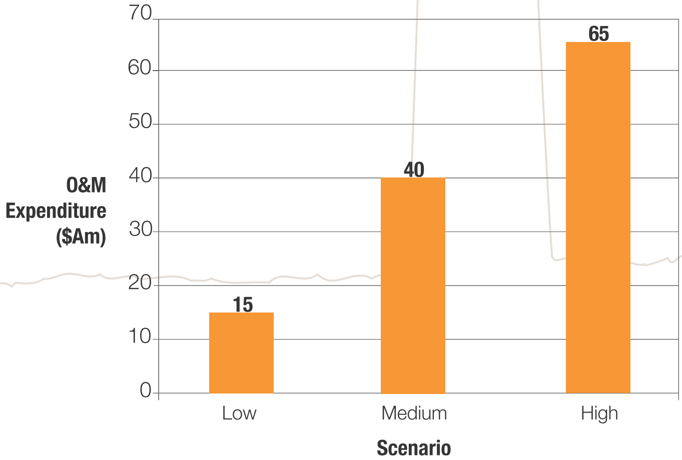


Figure 13: Operation and Maintenance Jobs

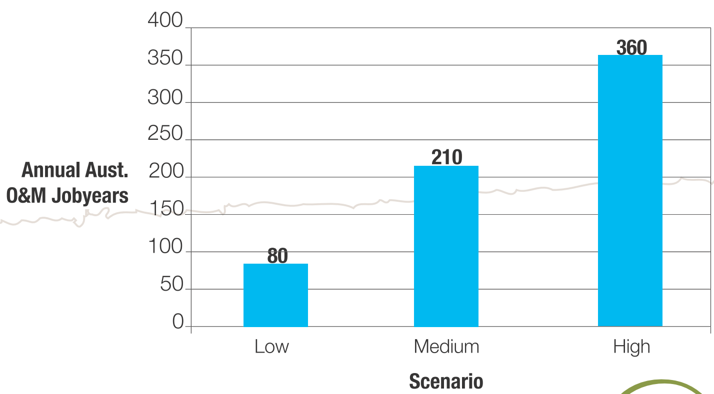


Table 7 Low scenario outcomes over 2002-7.

Year	Annual installations (MW)	Cumulative installed capacity (MW)	Annual cap. investment (A$m)	Annual Aust. component (A$m)	Aust. manufacturing & construction jobs (jobyears)	New O&M jobs
2002	32	101	58	29	120	4
2003	82	183	139	77	319	9
2004	131	314	213	129	536	13
2005	181	494	279	185	772	16
2006	230	724	337	247	1029	19
2007	280	1000	389	313	1306	21
		Total 2002-7	1415	980	4083	82

From MacGill and Watt (2003)

Table 8 Medium scenario outcomes over 2002-10.

Year	Annual installations (MW)	Cumulative installed capacity (MW)	Annual cap. investment (A$m)	Annual Aust. component (A$m)	Direct Aust. manufacturing & construction jobs (jobyears)	New O&M jobs
2002	32	101	58	29	120	4
2003	106	207	180	99	413	12
2004	179	386	291	176	733	18
2005	253	638	390	259	1081	23
2006	326	964	478	350	1458	27
2007	400	1,364	556	448	1867	30
2008	473	1,837	626	554	2310	32
2009	547	2,383	687	618	2576	34
2010	620	3,000	740	666	2776	35
		Total 2002-10	4006	3200	13334	214

From MacGill and Watt (2003)

Table 9 High scenario outcomes over 2002-10.

Year	Annual installations (MW)	Cumulative installed capacity (MW)	Annual cap. investment (A$m)	Annual Aust. component (A$m)	Aust. manufacturing & construction jobs (jobyears)	New O&M jobs
2002	32	101	58	29	120	4
2003	161	262	275	151	631	18
2004	290	552	471	285	1188	29
2005	419	971	647	430	1793	38
2006	548	1,519	803	588	2451	45
2007	677	2,196	943	759	3164	51
2008	806	3,002	1066	945	3936	55
2009	935	3937	1175	1058	4407	58
2010	1064	5000	1271	1144	4765	60
		Total 2002-10	6709	5389	22454	357

From MacGill and Watt (2003)

9.3 International Precedents in Market Creation

Predictions of significant employment growth due to expansion of renewable energy plants are not limited to Australia. Recent research into the impacts of renewable energy on employment in Europe to 2020 that takes into account jobs displaced in conventional energy technologies found the following (AP, 1999):

- In Europe, energy produced from renewable sources is predicted to increase by a factor of 2.4, from a base of 440 TWh in 1995 to 1,066 TWh by 2020.
- This increase in energy provided from renewable sources can result in the net creation of over 385,000 new jobs in Europe by 2020, of which over 35,000 are directly attributable to onshore wind farms.

Many other countries are pursuing much more aggressive targets backed up by long term policies that provide significant industry support. The European Union recently approved legislation to increase the amount of electricity generated from renewable sources from 14 percent to 22 percent by 2010. The European Wind Energy Association (EWEA) has projected the worldwide installed capacity for wind power to be 181,000 MW by this time. In Australia, even the 10 percent new renewables target potentially leading to 5,000 MW of wind generation would be only 2.8 percent of this worldwide figure, a relatively small contribution.

Germany: During 2001 Germany installed more than 2,000 new wind turbines with a total capacity of 2,659 MW, a 60 percent increase compared to 2000. In total, Germany has installed 11,000 turbines with a capacity of more than 8,700 MW, an average annual increase of 43 percent since 1998. The German government aims to install approximately 20,000 MW of turbines by 2010 and so produce at least 10 percent of the country's electricity from wind power, increasing to 25 percent by 2025.

USA: In the US, nearly 1,700 MW of new generating capacity worth $1.7 billion was installed in 2001. An average growth rate of 23 percent over the past five years has brought the total to 4,245 MW.

India: During 2001 India installed 240 MW, an increase of 28 percent compared to 2000. This brought the total to over 1,500 MW which by the year 2006 is expected to reach 2,800 MW. The Indian government has set a target of approximately 10,000 MW of renewable energy by 2012, 6,000 MW of which will be wind power (PIB, 2002).

France: France aims to increase its renewable energy sources from the current 15 percent to 21 percent of total demand by 2010. This will include investing10 billion euros (US$8.8 billion) to build 10,000 MW of wind generating capacity, a significant increase from the 78 MW as at the end of 2001 (RNS, 2002).

Denmark: In Denmark total capacity had risen to 2,417 MW by the end of 2001, which on average supplies 18 percent of the country's electricity. They aim to reach more than 5,500 MW by 2030 and so supply half of their electricity needs.

Spain: Spain has increased its installed capacity from 52 MW in 1993 to 3,550 MW in 2001. The Galicia region installed 973 MW between 1997 and 2001, and aims to install 2,800 MW within ten years representing 45 percent of their power capacity (EWEA, 2002).

10 Conclusion

Wind power is now the fastest growing energy industry in the world. In Australia, the industry has achieved an average annual growth rate of 118 percent between 1999 and 2002.

There are now 104 megawatts (MW) of wind power installed and running in Australia, a further 736 MW approved or under construction, and 1,400 MW formally proposed for planning approval. This total of 2,240 MW is sufficient to supply the energy needs of approximately 800,000 homes. However only half of this will be delivered without a stronger MRET target.

However, wind together with other renewable energy sources still only supplies a small proportion of demand in Australia -- approximately 10 percent. Most is from old hydroelectric facilities in Tasmania and the Snowy Mountains.

Wind is clearly an industry capable of generating significant social and economic benefits with negligible cost impact on end users. This is especially true for jobs in rural and regional Australia, which has borne the brunt of broader economic reform as services are progressively withdrawn. Increased efficiency and decreased labour intensity have worked to create very significant job losses in the electricity and coal industries.

Wind power has the potential to help reverse this trend. Wind power is labour intensive, with a significant proportion of jobs generated in regional Australia. As the industry achieves key levels of scale, up to 90 percent of turbine manufacture is expected to be sourced within Australia. Wind power also provides considerable income to farmers, and a potential boost to regional tourism.

Increasing the MRET from its current level to an additional 10 percent by 2010 would result in additional direct capital investment in Australia of $4.4 billion, additional operation and maintenance expenditure of $210 million, 3,500 additional direct Australian manufacturing and construction jobs, and 280 additional operation and maintenance jobs. Such increases in the MRET are considered to be necessary to have a significant long term impact on reducing greenhouse gas emissions (GHG), to capture a share in any future growth in overall electricity demand, and to develop the industry to a level where it will not only service Australia but also provide significant export income from products and services.

The costs of this expanded target are low: The average Australian family can expect to pay only $1.20 per month more in electricity charges for a 10 percent MRET. Even with this modest increase, Australian electricity prices would remain amongst the lowest in the industrialized world.
International wind turbine manufacturing companies including Vestas, NEG Micon and General Electric wind have seen the considerable potential for wind energy in Australia. They have already established a presence in Australia and are investing significantly.

Despite the obvious success of the MRET in promoting the growth of the renewable energy industry, the Energy Market Review report for the Council of Australian Governments (CoAG) suggested that the legislation be withdrawn.

It has been estimated that cumulative investment in wind power in the Australasian region will be US$115.3 billion by 2020 (EWEA, 2002). Without an expanded MRET, Australia risks its significant early-mover advantage in this substantial market. Australia could miss out on being part of the sustained global wind energy market expansion if government does not support local industry development to ensure international competitiveness.

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11 Appendix

Analysis Methodology for Calculation of Employment and Financial Indicators

The following is taken verbatim from MacGill and Watt (2003).

The challenges in assessing the economic and employment outcomes of particular industry sectors are magnified in the case of the renewable energy industry by its diversity, relative youth and rapid growth. In the first stage of this report, we discussed these difficulties while making estimates of the economic development and job creation arising from four different Australian renewable energy projects including the Albany wind farm.

The challenge of making such estimates is that much greater when exploring scenarios of future Australian wind industry development given that industry's rapid growth and transformation here, and the many possible development paths wind power might take over the coming decade. Some of the key issues are outlined below, along with our chosen strategy for managing the many approximations and assumptions required.

Capital costs:

The capital costs of wind farms can vary markedly with factors including project scale, site accessibility, turbine technology, finance arrangements and grid connection requirements. The treatment of tax, grid connection costs and finance add to the challenge of accurate project costs estimates. Available data for recent Australian projects suggest installed costs of A$1.7 -2.1m/MW[16] -- some A$38m for a typical 20 MW project.

The capital costs of wind generation continue to fall – some 20 percent over the last five years according to BTM Consult (2002) who project installed costs may fall a further 30 percent between now and 2010. One key factor appears to be growing machine sizes. In 2001, megawatt machines accounted for half of all installed capacity, up from 40 percent in 2000 (Gipe, 2001). Multi-megawatt machines are now on the market. Another factor is the move to larger wind projects in many countries (REPP, 2002).

Future costs here in Australia will depend on global trends, the size of Australian projects, local market growth with associated local economies of scale and the extent of local manufacturing. It can be expected that Australia will largely use equivalent machines to those on the international market. In line with world trends, currently proposed Australian projects are also on average significantly larger than present projects, an average 70 MW for the 27 planned projects described by AusWEA (2002).

Australian content:

The relative costs of the various components and associated activities in developing a wind farm can vary markedly. An approximate cost breakdown is 50 percent for the turbine, rotor and associated components, 15 percent for the tower with the remainder spent on site preparation, installation and project development (DWIA, 2001). Current grid-connected wind farms in Australia have utilised largely imported machines and components other than the towers and electrical interconnection equipment. Estimating the Australian component of total investment requires some significant approximations and assumptions. Nevertheless, with a focus on local sourcing where possible, recent projects have achieved estimated Australian content (by value) of 44-50 percent[17] of capital costs.

The key driver of future Australian content is the establishment of local Australian manufacturing. Pacific Hydro (2002) proposes to establish local manufacturing as part of its 120 wind turbine Portland project, and estimates it can achieve 90 percent local content in the longer term. This is contingent on the industry having a clear future and there being sufficient sales to justify further investment in manufacture. Vestas (2002) has outlined local manufacturing options for its 1.75 MW machine including nacelles, towers, blades, specialised components and controllers that can achieve 95 percent local content by value. The advantages of local manufacturing include lower prices on the machines, faster and cheaper O&M services and reduced delivery lead times. The key to its establishment, particularly achieving a number of local players, is sufficient local market size.

Estimating the proportion of capital investment that is spent in the region of particular wind projects is difficult and highly project dependent. Much of the site preparation and construction can be sourced from local businesses. Some projects like the proposed Portland development have sought additional local benefits through plans for local manufacture – in this case some 27 percent of investment is slated for the Portland region, and 70 percent in the state of Victoria (SKM, 2001).

Manufacturing and installation jobs:

Estimating the direct Australian jobs created in the manufacture and installation of wind projects here is difficult and subject to numerous uncertainties as discussed in MacGill et al. (2002). International and Australian studies have used a range of different definitions, approximations and assumptions leading to a wide range of estimates. Earlier studies are also of limited value given the rapid progress of the industry, including larger machine sizes, over the last five years worldwide.

Estimates of manufacturing and installation jobyears created per megawatt of installed wind capacity can therefore vary markedly as shown in table x[18]. The general range is somewhere between 3 and eight total jobyears per MW. Note that one might expect higher relative employment in Australia in comparison with the US and Europe (where many of these studies have originated) given the lower cost of labour here (BTM, 2001).

It can be expected that most direct installation and construction employment requirements will be sourced regionally. Manufacturing employment breakdowns for the different components does not precisely follow the cost breakdowns above due to different labour intensities for tasks such as towers and blades. Nevertheless, a rough approximation of where employment will be generated can be derived from where capital expenditure occurs.

It is widely expected that there will be a reduction in manufacturing and installation employment with industry growth and development including larger machine and project sizes. One approach for modelling this is to have employment per MW of new capacity fall in line with the decline in capital costs of wind power over time (BTM, 2001).

Ongoing O&M jobs:

Studies estimating ongoing O&M jobs show considerably less variation than seen for manufacturing and installation. Estimates vary from 0.225 ongoing jobs per MW installed (ACIL, 2000), 0.2 jobs/MW (EPRI, 2001), 0.19 jobs/MW installed for a recent Australian project (MacGill, 2002), 0.1 jobs/MW (REPP, 2002) to 0.08 jobs/MW on recent large-scale US wind projects (Enron, 2000).

O&M employment with wind power is clearly low in comparison with that for manufacture or installation although the typical 20 year life of installed wind would see perhaps a total of two O&M jobyears per MW – around one third of the total jobyears in manufacturing and installation. Nearly all O&M jobs will be filled locally.

Again, it is widely expected that O&M employment per MW will fall with the coming larger more reliable machines and bigger projects.

One estimate of the varying direct labour requirements for the different components and tasks in wind projects is that of REPP (2001), as shown in Figure 1. The corresponding estimates of the types of jobs created by these projects are shown in Figure 2 (overleaf).

Ongoing O&M expenditure

O&M requirements for wind generation varies with factors including the type, duty regime and age of the equipment. More recent equipment is showing far greater reliability than many of the earlier machine types, and this fall in O&M requirements may be expected to continue. Estimates of ongoing O&M expenditure for installed wind capacity vary around the range of 1 percent of total capital installed costs each year (DWIA, 2002). A significant proportion of this will be spent locally.

This expenditure is low in comparison to the capital investment for wind generation equalling around 20 percent of capital expenditure over the typical 20 life of installed project.

Figure 1 **Estimated direct labour requirements for different aspects of wind project development (REPP, 2001).**

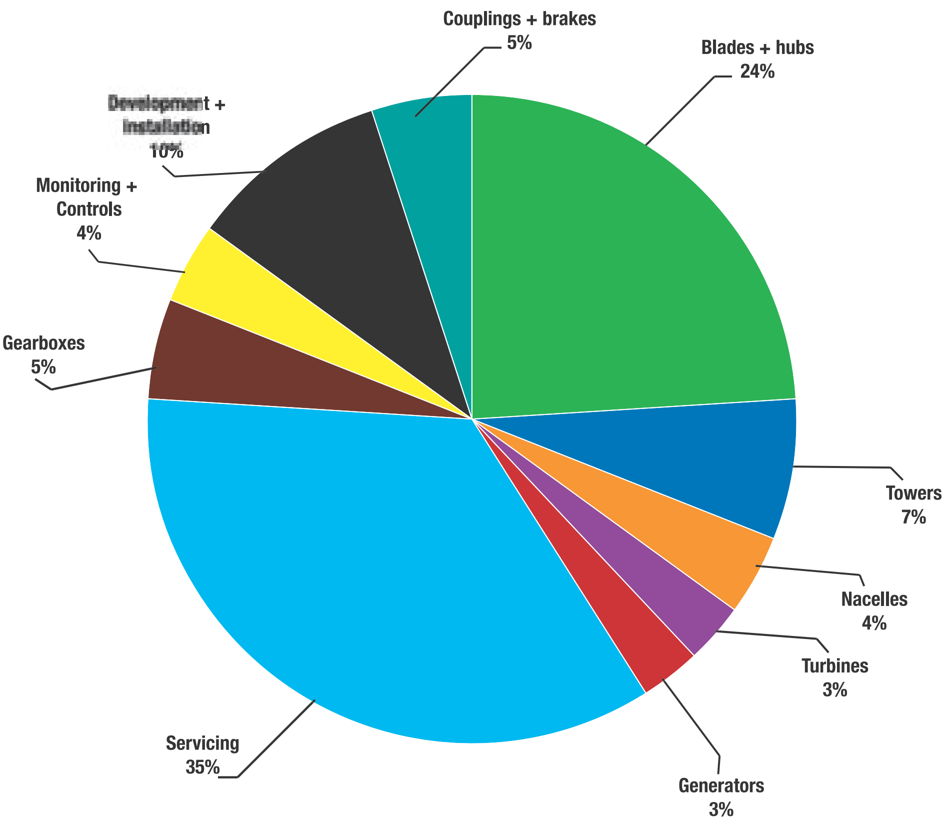
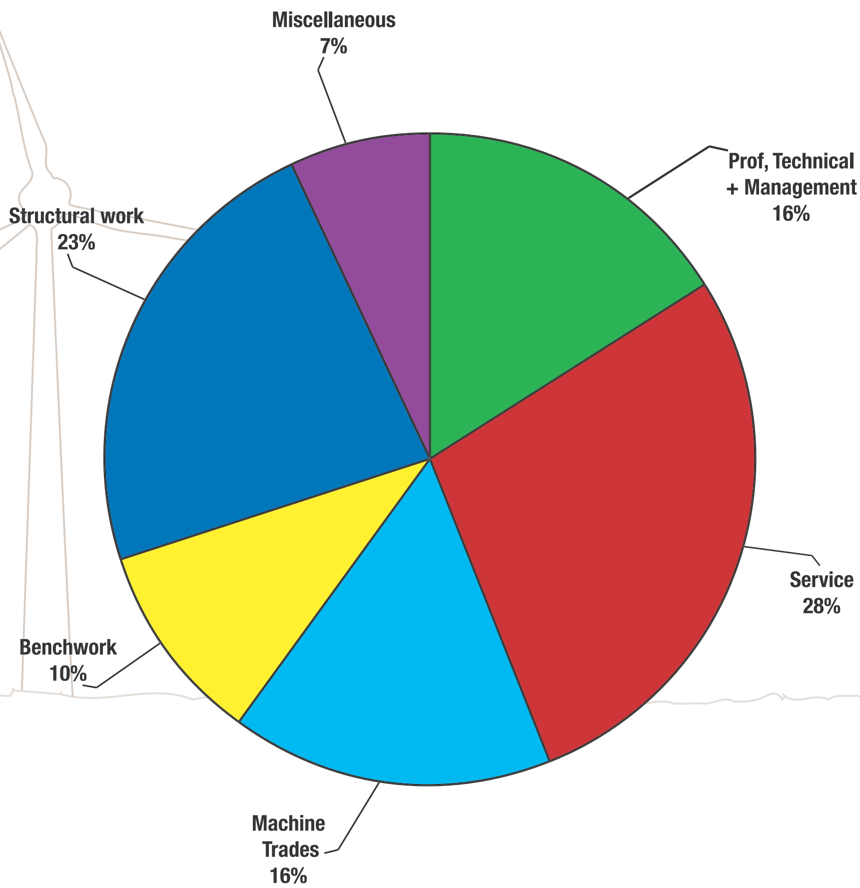


Figure 2 **Estimated occupational labour requirements for wind project development (REPP, 2001).**



Footnotes

[1] Assumes a 91percent capacity factor, and includes jobs to supply coal.
[2] Assumes a capacity factor of 30 percent.
[3] The 'Low' scenario sees all 1,000 MW installed by 2007. The estimate of total generation over the period is therefore 9,500.

[4] The SEI Development Fund requires a total investment of $375 million and is financed 50:50 by the public and private sectors. It was incorporated into the model in order to encourage investment in NSW – understandable given that the report was written for the NSW government.

[5] Note that this is highly contingent on foreign exchange rates.
[6] From MacGill and Watt (2003).
[7] From MacGill et al. (2002).
[8] Is for Albany wind farm case study from MacGill et al (2002).
[9] Assumes a capacity factor of 37 percent.
[10] Assumes a 91 percent capacity factor, and includes jobs to supply coal.
[11] Assumes a 91percent capacity factor, and includes jobs to supply coal.
[12] Assumes a capacity factor of 30 percent.
[13] The 'Low' scenario sees all 1,000 MW installed by 2007. The estimate of total generation over the period is therefore 9,500.
[14] The 'Low' scenario outcomes are for 2007.
[15] The 21.6 MW Albany project cost an estimated A$45m (MacGill et al, 2002) and the 21MW Toora project is estimated to cost $35m (Stanwell, 2002).
[16] The Albany project had estimated 44 percent Australian content (MacGill et al., 2002) while the Toora project has achieved near 50 percent (Stanwell, 2002).
[17] See MacGill and Watt (2003) for table x; this report still in draft form at press time.

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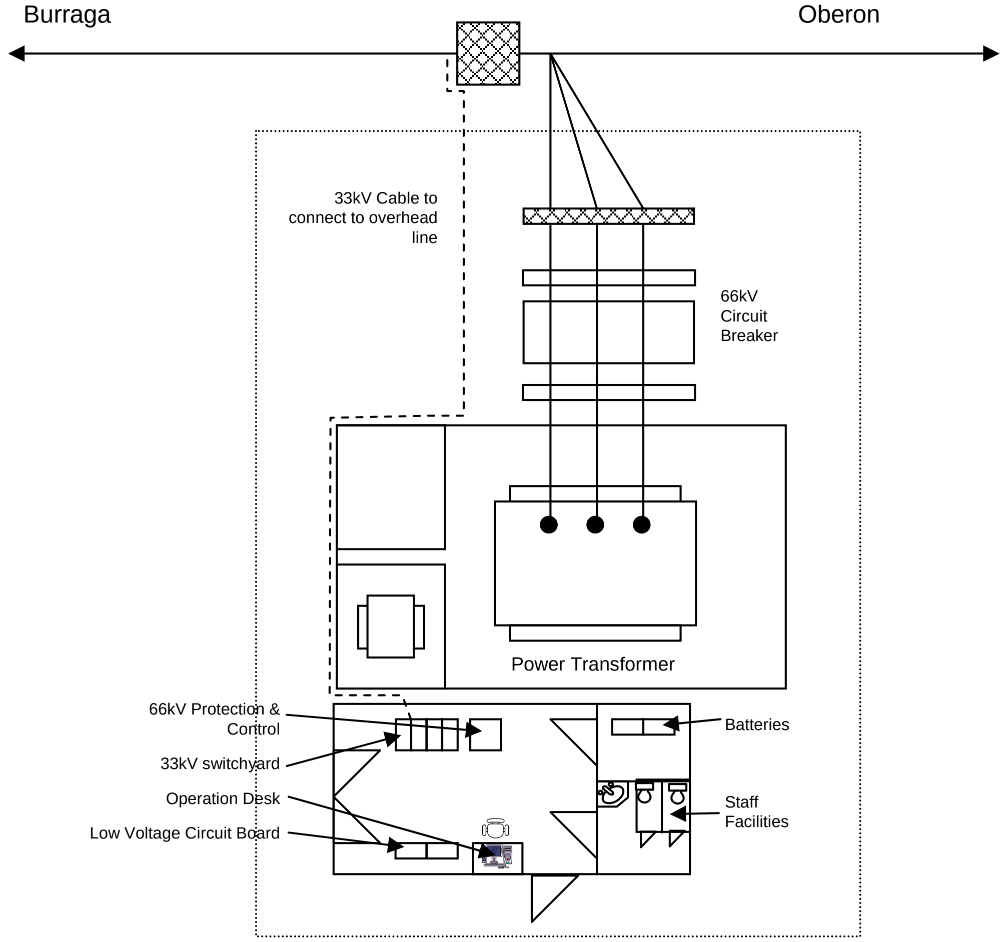
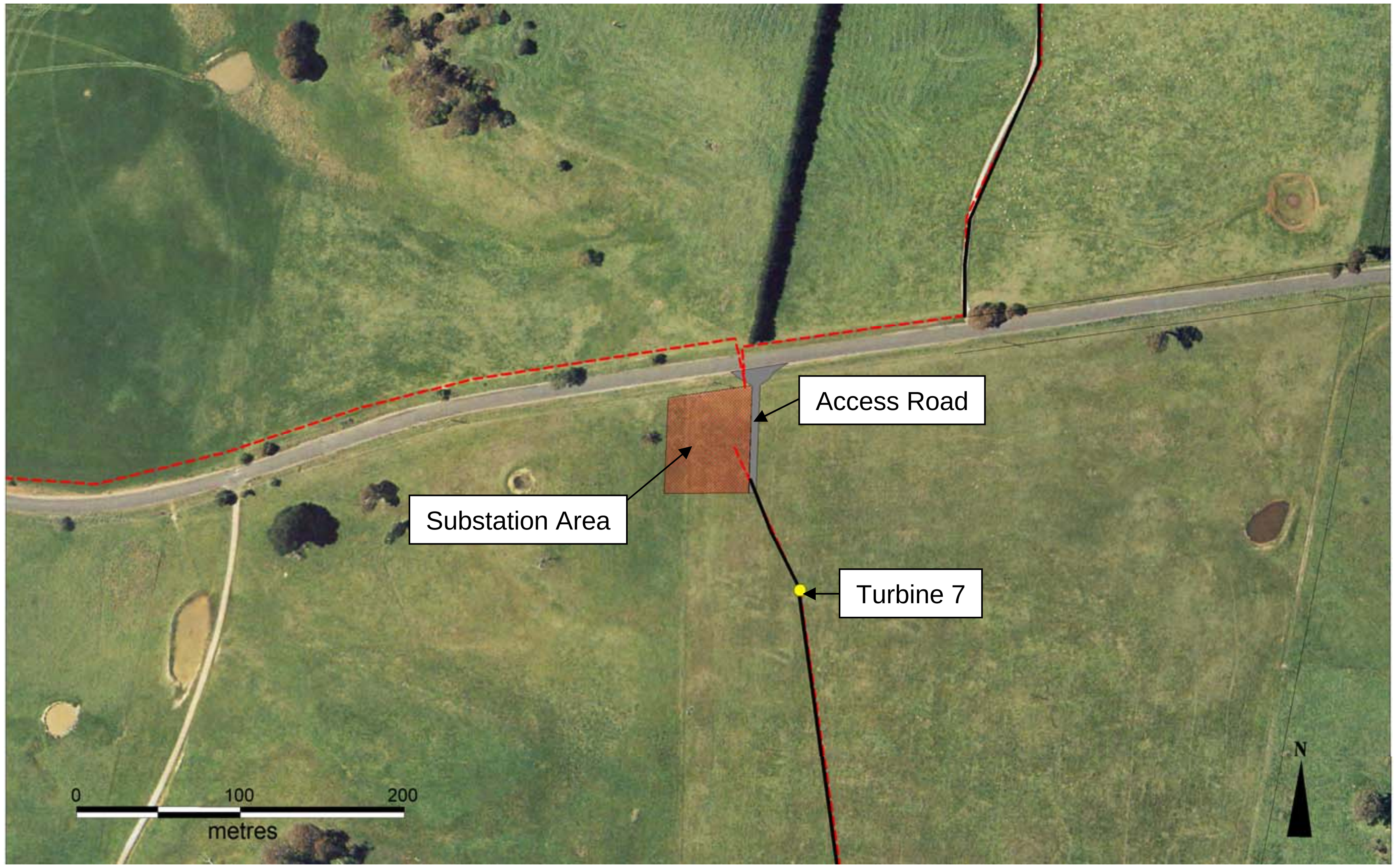
Typical Substation Design



Substation Layout



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Black Springs Wind Farn
9 x 2.1MW WINDFARM SUBSTATION

Map, Design and Layout

PREPARED BY: Bernhard Voll

REV A
24/04/2007

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Black Springs Wind Farm

Shadow Flicker Study

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Executive Summary

Shadow Flicker is a term used to describe the change in light intensity observed when a wind turbine blade casts an intermittent shadow upon a receptor. Through consideration of the potential receptors (homes), wind turbine and sun position, the number of hours of theoretical shadow flicker can be determined. Such modelling has been carried out for an indicative wind turbine layout proposed for the Black Springs Wind Farm. A number of residences in the vicinity of the wind farm has been selected and analysed.

There is only one residence not participating in the project and potentially experiencing flickering shadows for a maximum of 21 hours per year. This property is surrounded by trees masking any shadow generated by turbines and therefore no impact from shadow flicker is expected.

No consideration of screening due to vegetation or structures is considered in the calculation model and such features are in reality, likely to further reduce any shadow flicker impact.

1 Introduction

The Black Springs wind farm is located approximately 25 km south of Oberon in NSW. The project will consist of 9 wind turbine generators with a hub height of approximately 80m and rotor diameter between 82m-88m. For the purpose of this study the analysis is based on an indicative turbine layout consisting of 9, Suzlon S88 turbines (hub height 80m, rotor diameter 88m).

Figure 1-1: Overview Map

For the purpose of this study the analysis is based on an indicative turbine layout consisting of nine Suzlon S88 turbines with a hub height of 80m and a rotor diameter of 88m.

In extreme situations the flickering shadow effect created by the wind turbine blades across the sun can be disturbing to residences located in the vicinity of the wind farm. This study explains the shadow flicker effect with regard to wind turbines, and presents results of an impact analysis carried out for the residences in the vicinity of the Black Springs Wind Farm.

2 Background

2.1 Shadow Flicker

Shadow flicker is the term given to the change in light intensity caused when a moving object casts a shadow on an incident surface. With regard to wind farms, the effect is caused by the rotating blades casting a moving shadow over a residence.

Shadow flicker can cause disturbance to residents if the orientation of the turbines and a home are such that the residence experiences significant periods of flicker impact. For example if a person is within a building, shadow flicker from a turbine will result in an intermittent variation in the natural light intensity. If the regular changes in light intensity levels are high or experienced for significant periods of time, then the shadow flicker may cause a nuisance.

For such a situation to arise the following conditions are required;

- A sufficient level of sunlight – If there is a significant level of cloud then the shadow flicker is not observed

- The line of sight between the receiver and the turbine must be clear – Obstructions such as vegetation or buildings will prevent the flicker affect being observed. Windows need to be positioned such that the flicker is actually observable within the house.

- The turbine operating with the rotor orientated towards the receptor – If the rotor is facing perpendicular to the line between the sun and the receiver, very little flicker will be observed, while if the rotor is facing a residence some flicker may be observed. Therefore wind direction will influence the level of flicker experienced.

- The sun must be in the correct position[1] – The sun's position changes throughout the day and across the year, and is a key variable in the determination of the number of shadow flicker hours experienced.

2.2 Impacts

It has been scientifically[2] established that frequencies of light flicker above 2.5 hertz may cause disturbance and nuisance to people. This was established for both the general population and the 2% who suffer from epilepsy. Of those that suffer epilepsy, 5% have exhibited an adverse reaction to flicker effects above 2.5 to 3 hertz.

Wind turbines of the size considered for this project (80m-90m rotor) have a rotor rotational speed[3] resulting in a flicker frequency 0.6-1.0 Hertz which is significantly lower than that considered to be the cause of nuisance or disturbance as described above. Although an impact cannot be neglected it is considered to be minimal and more affecting the comfort. To minimise potential impact from Shadow Flicker, sufficient distance between houses (having large windows and sides facing the turbines without screening through vegetation) and wind turbines should be included in the design. If sufficient distances cannot be achieved in the design process it is possible to plant screening vegetation which would effectively eliminate impacts from shadow flicker.

[1] A minimum sun elevation of 3° over the horizon is used for the purpose of this study

[2] Source: Verkuijlen and Westra, 1984 and Wind Energy Handbook, Burton, Sharpe, Jenkins and Bossanyi

[3] The rotational speed of the SUZLON S88 turbine is 15.79 rpm at rated power

2.3 Calculation Method

The calculation of the number of shadow flicker hours experienced by a receptor is determined by modelling the movement of the sun throughout the day and year. The location of houses (receptors) and turbines are input as well as a digital model of the topography. By identifying where the site is on the earth, the suns trajectory (elevation and azimuth) can be modelled, enabling the calculation of the amount of time during which the sun, turbines and receptor are correctly aligned in order to result in shadow flicker.

The modelling makes the following assumptions;

- The sky is 100% clear with no allowance for mist, fog, cloud etc.
- Turbines are always rotating
- The rotor of the turbine is always orientated such that it is facing the receptor
- There is a 2 km limit to the human perception of shadow flicker
- The sun can be represented as a point light source
- With exception to the consideration of terrain there exists a clear line of site between sun, turbine and receptor. No allowance is made for any obstructions such as vegetation or buildings
- The sun must be 3 degrees above the horizon

Considering these calculation assumptions it can be seen that the model is conservative. To provide some refinement of the prediction, the number of cloudy days in the region is also taken into account. Information from the Oberon Buckley Crescent Bureau of Meteorology station[4] indicates an annual median value of 98 cloudy days per year. Based on this figure, a reduction of 27% is applied to the theoretical number of shadow flicker hours.

The wind is a variable resource and there will be times when the turbine rotors are not turning. The assumption that the turbines are always rotating during daylight hours is incorrect however considered a reasonable and conservative simplification for the purpose of this study.

As the distance from the turbine increases, the intensity of the shadow cast by the turbine blade decreases. Shadows that are cast closer to the turbine are more intense as a greater portion of the sun is obstructed by the blade. Germany is the only country which has a comprehensive guideline[5] regarding shadow flicker impacts. This guideline considers that at a distance of 2 km, shadow flicker affects are negligible. Other sources[6] state that the flicker affect should not be perceivable to the human eye at distances of approximately 10 rotor diameters or 900m. For the purpose of the study a conservative approach has been taken and houses up to 2km away from a turbine have been considered.

[4] Figure obtained from http://www.bom.gov.au/climate/averages/tables/cw_063063.shtml

[5] Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen (WE-Schatten-Hinweise)

[6] http://www.dti.gov.uk/renewables/renew_3.5.1.4.htm

3 Black Springs Wind Farm

The Black Springs Wind Farm will occupy two slightly undulating farm properties south of the Oberon-Burraga Road. For the purpose of the study a representative layout of nine Suzlon S88 turbines with an 88m rotor diameter and a hub height of 80m have been used.

Fourteen potential shadow receptors were identified based on topographic map and site survey. Only receptors that fall within a 2 km radius of any turbine have been included as shadow flicker impacts are considered negligible at distances greater than 2km.

Receptor No.	Distance to Closest Turbine (m)	WGS84 Zone 56 UTM Coordinates		Within Analysis Envelope
		Easting (m)	Northing (m)	
1 – House 25	484	749270	6249750	Yes
2 – House 24	316	750492	6249986	Yes
3 – House 20	1,228	751880	6250600	Yes
4 – House 21	1,561	752275	6250190	Yes
5 – House 22	1,447	752151	6250042	Yes
6 – House 23	1,402	751941	6249533	Yes
7 – House 31	1,156	751614	6248514	Yes
8 – House 27	504	750004	6249216	Yes
9 – House 28	467	749393	6248591	Yes
10 – House 32	1,158	750071	6246956	Yes
11 – House 33	1,615	750520	6246520	Yes
12 – House 34	1,533	750120	6246480	Yes
13 – House 35	1,793	749630	6245950	Yes
14 – House 29	1,072	748320	6247030	Yes

Table 3-1: Shadow Flicker Receptors

Figure 3-1: Map showing residences with shadow receptors[7]

Turbine	WGS84 Zone 55 UTM Coordinates	
	Easting (m)	Northing (m)
1	749170	6247684
2	750311	6248122
3	749386	6248124
4	750333	6248503
5	750487	6248773
6	750513	6249041
7	750387	6249544
8	749736	6249883
9	750714	6250212

Table 3-2: Turbine Positions

[7] Dwellings 18, 19 and 30 are outside the analysis envelope

4 Results

Calculation of shadow flicker impacts was carried out for the 14 receptors identified. The calculations determine that only two of the receptors are likely to observe any shadow flicker impacts.

Once an adjustment is made for the annual percentage of cloudy days, the impact in terms of shadow flicker hours are found to be minimal. There is only one relevant property[8] (House 25 – Miller) potentially experiencing shadow flicker for a maximum of 35 hours per year. As this property is surrounded by trees especially towards the turbine positions, all shadows will be masked by this vegetation and practically no shadow effect will occur at this residence. Figure 4-2 shows a detailed aerial view of that residence. Although this property is considered a non-participating landowner and as such relevant it should be noted that the Developer has signed an agreement with the Landowner considering the acceptance of higher noise levels than defined in the NSW Planning Guidelines. This effectively changes this residence to a status similar to a participating landowner and therefore it no longer is considered relevant. However, for the purpose of completeness and accuracy, the results for this residence are still shown in detail.

Table 4-1 shows the detailed results of this analysis. Figure 4-1 shows the shadow flicker map of the wind farm area with various colours representing specific bands of hours of shadow flicker[9] per year.

Receptor Description	Annual Shadow Flicker Hours (Theoretical)	Annual Shadow Flicker Hours (Considering 27% cloud cover [10])	Maximum Period [min] of Shadow Flicker (worst day)[11]	Time (worst day)	Date (with maximum shadow period)
1 – House 25	48	35	50	07:00 – 07:50	13.04 – 29.04 17.08 – 31.08
2 – House 24	52	38	60	08:30 – 09:30	03.06 – 29.06
3 – House 20	0	0	0		
4 – House 21	0	0	0		
5 – House 22	0	0	0		
6 – House 23	0	0	0		
7 – House 31	0	0	0		
8 – House 27	56	40	50	05:50 – 06:40	01.01 – 02.01 14.01 – 20.01 29.11 – 15.12
9 – House 28	7	5	20	06:20 – 06:40	26.02 – 04.03 09.10 – 18.10
10 – House 32	0	0	0		
11 – House 33	0	0	0		
12 – House 34	0	0	0		
13 – House 35	0	0	0		
14 – House 29	0	0	0		

Table 4-1: Results of Shadow Flicker Analysis

8 A relevant property is considered not a participating landowner

9 The shadow hours shown in this map do not account for cloudy days and show the theoretical maximum assuming 365 clear days per year

10 Based on annual average number of cloudy days as recorded by Bureau of Meteorology

11 Clear day assumed

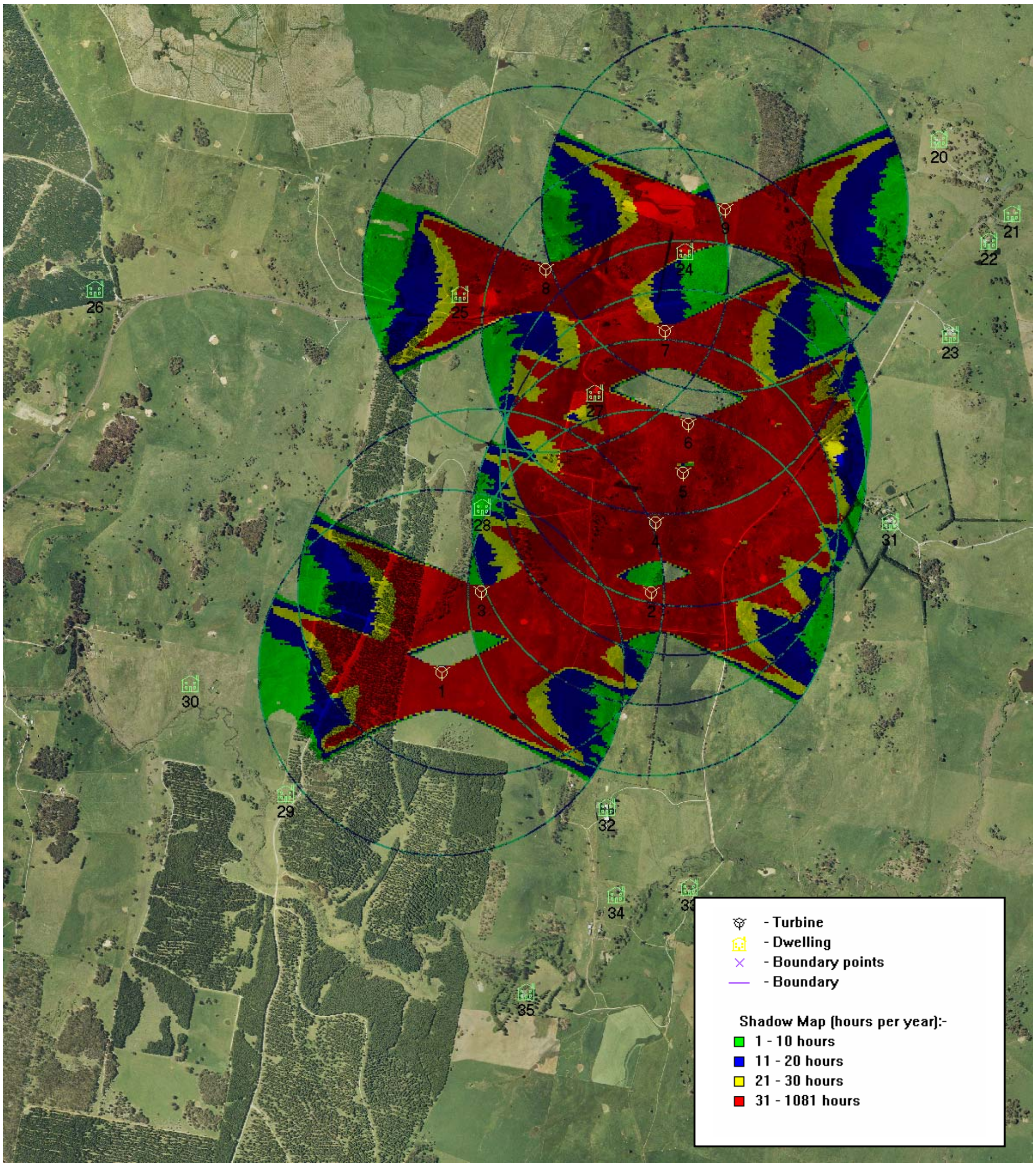


Figure 4-1: Shadow Flicker Map

Figure 4-2: House 25 Detail

House 27 is currently used as shed and therefore not relevant.

House 24 has some trees planted towards the shadow-making turbine No. 9, therefore it is expected that shadow will be masked by these trees. In addition to this the main windows of this house are oriented north and therefore shadow flicker is not likely to have an impact on the amenity of the residents in that house. If masking by the existing trees is not sufficient and the residents experience an annoying level of impact it is recommended that the Developer plants additional trees to mask any impact from shadow flicker. Figure 4-3 shows a detailed view of House 24. House 24 is also a participating landowner and as such not considered relevant.

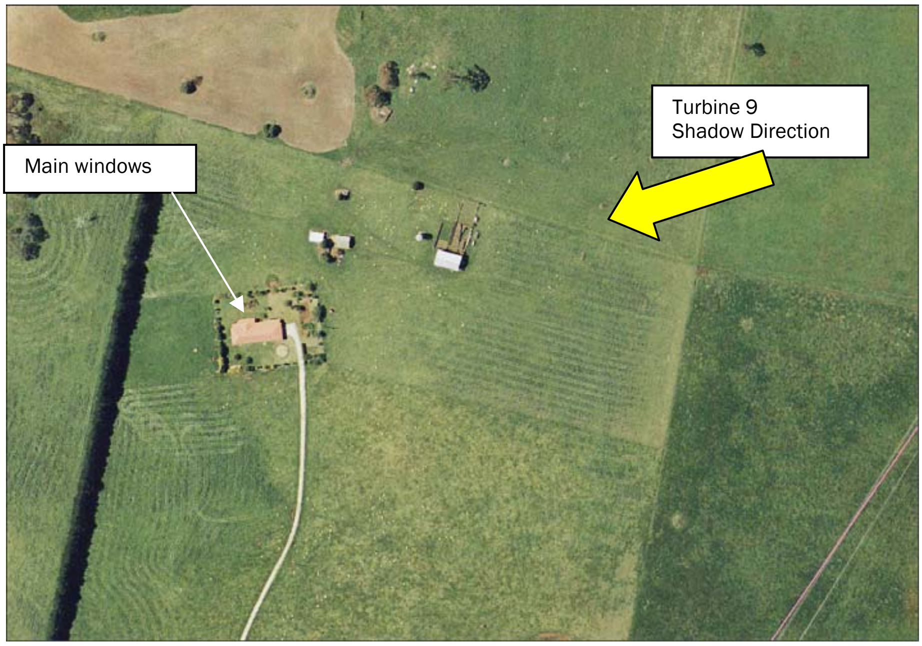


Figure 4-3: House 24 Detail

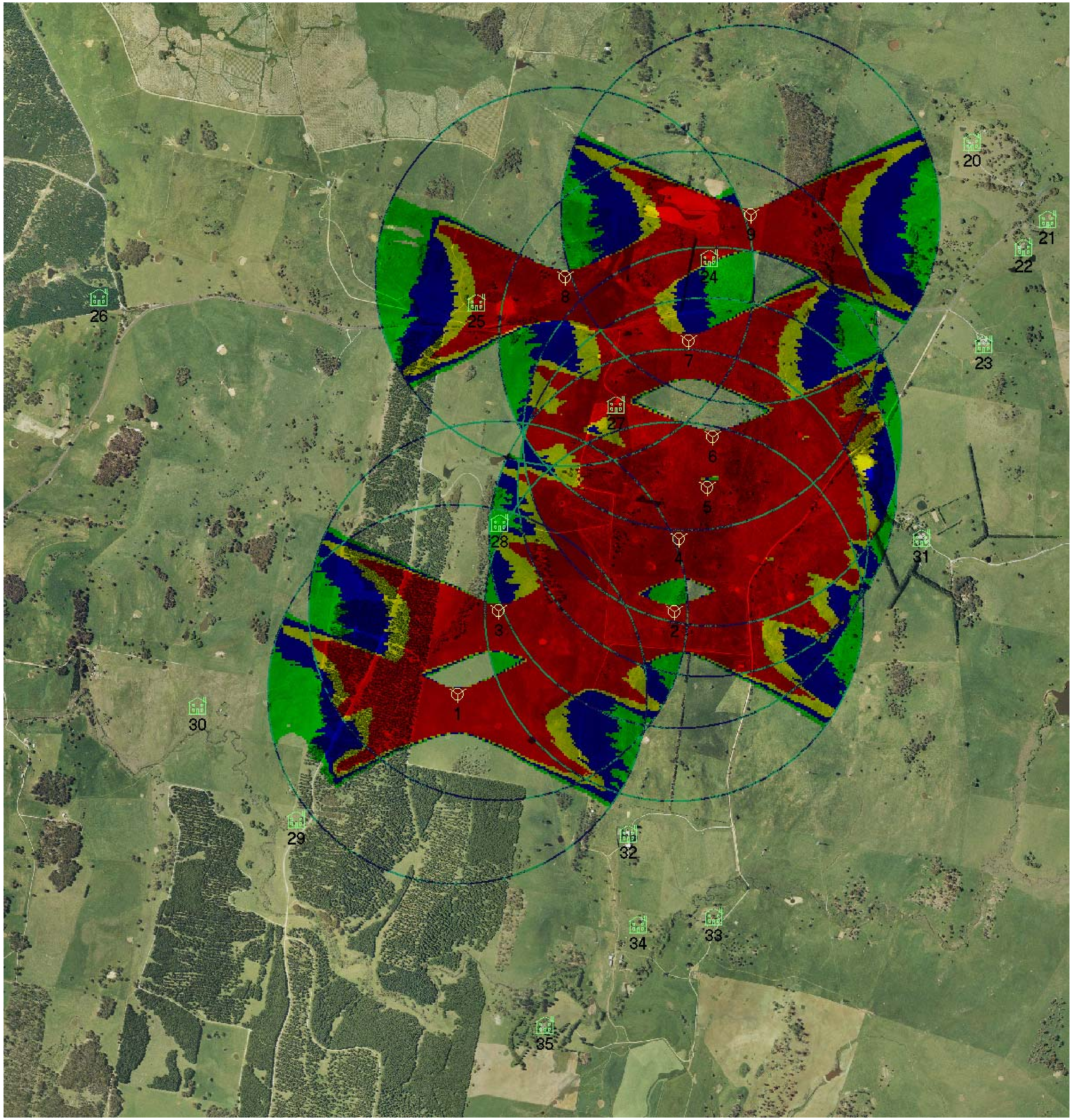
House 28 (Daisybank) is owned by a participating landowner and as such not relevant. There are currently no trees with the potential to mask shadow flicker although it is worth noting that there are trees in further distance from the house between the main line of turbines and the house potentially masking any shadows. Due to the very short period of potential shadow flicker of no more than 7 hours per year this impact potential is considered acceptable. If the resident experiences an annoying level of impact it is recommended that the Developer plants additional trees to mask any impact from shadow flicker. Figure 4-3 shows a detailed view of House 24. House 24 is also a participating landowner and as such not considered relevant.

Figure 4-4: House 28 Detail

5 Conclusion

Based on the observed results through application of conservative modelling and based on the vegetation seen on the site, no impact of shadow flicker upon relevant residences in the vicinity of the Black Springs Wind Farm is expected.

In the unlikely event that residents experience an annoying level of shadow flicker (especially House 24 – Acqualoria) then it is recommended to plant screening vegetation which effectively eliminates any impact.



- Turbine
- Dwelling

Shadow Map (hours per year):-

- 1 - 10 hours
- 11 - 20 hours
- 21 - 30 hours
- 31 - 1233 hours

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Black Springs Wind Farn
Shadow Flicker Report Maps

PREPARED BY: Bernhard Voll

REV A
24/04/2007

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PROJECT: REVISED STATEMENT OF COMMITMENTS- BLACK SPRINGS WIND FARM	
CLIENT:	WIND CORPORATION AUSTRALIA
OUR REF.	23219
DATE:	14 JUNE 2007
APPROVED BY:	KATRINA O'ROURKE
SIGNATURE:	
CHECKED BY:	STEVE MCCALL
SIGNATURE:	

1. INTRODUCTION

RPS Harper Somers O'Sullivan act on behalf of Wind Corporation Australia in providing additional information in response to comments from the Department of Planning and public submissions for Black Springs Wind Farm, Oberon Shire Environmental Assessment.

A revised Statement of Commitments has been prepared to outline the environmental management, mitigation and monitoring measures that will be implemented with the development of the Black Springs Wind Farm in response to Department of Planning comments and information from public submissions. A number of ameliorative measures have been designed into the project to minimise the environmental impact of the overall development. Consideration has been given to the industry 'best practice' mitigation measures listed in the *NSW Wind Energy Handbook* (SEDA 2002) and these measures have been implemented where practical. The table below provides a compilation of the main environmental impacts and associated mitigation measures proposed to ameliorate the impacts as part of the revised Statement of Commitments for the Black Springs Wind Farm. Wind Corporation Australia is committed to implementing the environmental safeguards and measures as listed in this table.

Revised Draft Statement of Commitments

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
1	Greenhouse emissions from construction machinery	• ensure machinery is adequately serviced to ensure efficient operation; • turn off engines rather than idle for long periods	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	ECMP prepared by HSO Planning Consultant	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
2	Visual impact from construction and on-going operation of turbines on adjacent residents	• plant screening for those residences most impacted by the proposal; • ncreasing turbine size to further reduce turbine numbers while balancing energy generation and associated benefits; • ocating powerlines and cabling underground to remove visual clutter and allow uninterrupted farm activities across the remaining areas of the subject properties; • se of muted colours (off white) with a matt finish for turbines to reduce the visual contrast against the background; • all turbines to be the same colour and size; • turbine blades to rotate in the same direction and all turbines to operate at the same time, except when undergoing maintenance work; • the turbine layout will be clustered as close as possible and where possible in a linear layout to minimise cumulative visual effect of the farm when viewed from a distance. •	Address via Environmental Management Plan	Actions implemented via project officer during construction activities	EMP prepared by HSO Planning Consultant	Prepare EMP prior to the construction phase	Actions recorded as part of EMP	Comply with EMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
3	Visual impact from on-going operation of turbines on driver distraction	• warning signs to forewarn approaching motorists of visual distraction; • development of a viewing area and educational signage to create a safe viewing location.	Address via Environmental Management Plan	Actions implemented via project officer during construction activities	EMP prepared by HSO Planning Consultant AWC to arrange signs and viewing area	Prepare EMP prior to the construction phase	Actions recorded as part of EMP Signs erected and viewing area established	Comply with EMP mitigation measures
4	Noise emissions from construction and maintenance machinery	• Ensure machinery is adequately serviced to ensure noise efficient operation; • Minimise use of engine braking • Schedule noisy activities to a suitable time to avoid sensitive times of the day for adjoining development; • Relocate the noise source away from receivers or behind existing structures that can serve as a barrier; • Change the orientation of equipment away from receivers; • Adopt 'quiet' work practices, such as turning off truck engines rather than idling for long periods; • Informing neighbouring properties of the proposed noise activities and duration; • Educating staff and contractors about noise and quiet work practices.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	ECMP prepared by HSO Planning Consultant	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
5	Noise emissions from turbines	• Lease affected property for the life of the project Installation of double glazed windows or change in blade pitch		Investigate any noise complaints should they arise and develop appropriate mitigation measures	AWC to address noise complaints	As required	Complaints and remedial actions recorded in EMP	Comply with SA EPA guidelines for noise
6	Exhaust emissions from machinery	• Ensure machinery is adequately serviced to ensure efficient operation; • Turn off engines rather than idle for long periods. • Comply or perform better than the predicted maximum noise levels and conform to SA EPA guidelines	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor	During construction and maintenance works	Construction contractors signing they have read the ECMP	

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
7	On-site erosion from construction operations	• Prepare an Erosion & Sediment Control Plan for all activities; • Exposing the smallest possible area of land for the shortest possible time; • Saving topsoil for reuse; • Controlling runoff onto, through and from the site; • Using erosion measures to prevent on-site damage; • Using sediment control measures to prevent off-site damage; • Rehabilitating disturbed areas quickly; and Maintaining erosion and sediment control measures.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Engineering consultant	Prior to construction period	Maintenance actions recorded in a register as part of ECMP and EMP	Landcom's Soil & Construction – Managing Urban Stormwater "Blue Book"

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
8	Dust from construction activities	• Minimising the surface area disturbed by excavation, stockpiling and/or filling locations where practical; • Confining vehicle movements to paved roads or available hard stand areas, where practical; • The use of a water cart, as appropriate, to eliminate wind blown dust; • Use of sprays or sprinklers on stockpiles or loads to lightly condition the material; • Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; • Covering stockpiles or loads with polythene or geotextile membranes; • Restriction of stockpile heights to 2 m above surrounding site level; • easing works during periods of inclement weather such as high winds.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
9	Potential for bird and bat impacts from blades during turbine operation	• An Adaptive Management Programme will be enacted for the proposal. This will ensure that impacts upon birds and bats (and the environment in general) are monitored. Where issues are identified, appropriate responses will be implemented to ensure issues are addressed.	Address via Environmental Management Plan	On-going monitoring for bird and bat impacts during the operation of the wind farm	HSO Ecological consultant	Post construction period	Monitoring as per the Flora and Fauna Assessment recommendations	Contribute to the scientific research of bird and bat strikes – compare results against current identified potential for impact
10	Vegetation removal & spread of weeds	• Restrict clearing to only areas required for turbine and facility structures. • Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal • Sharing of easements in common trench for power and turbine control cabling	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor and AWC	During and post construction works	Maintenance register recorded as per EMP	Actions as per "best practice" for weed control

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
11	Potential for impact on unidentified items of Aboriginal cultural heritage	• Locate turbines on ridge crests that are exposed to the elements and will not affect sensitive landforms. • Access tracks should be constructed following the same path as the cable trenching to avoid unnecessary impacts on any sensitive landforms. • A qualified archaeologist should be on-site for clearing of vegetation for the construction of access tracks. All monitoring activities will be undertaken under a section 87 permit. In the event that a site is identified during construction, work will cease immediately, the Pejar Local Aboriginal Land Council will be notified and an application made under section 90 of the National Parks & Wildlife Act will be made to remove or destroy as appropriate.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities to ensure archaeologist is on site during clearing	AWC in consultation with Aboriginal heritage consultant and local Aboriginal land councils.	During the construction period	Actions recorded in ECMP and EMP	Actions in accordance with Department of Environment and conservation guidelines

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
13	Potential interruption of the Black Springs to the Burraga Fire Tower VHF signal	• Place a collector / repeater station on the towers that impact the signal • An On-site Signal Interference Study will be prepared relating to television and telecommunication signals pre and post construction. This study should allow quantitative comparison after installation with a comparison survey. The results of the On-site Signal Interference Study shall be provided to the Department of Planning. Remedial measures, if required, may include improved antennae, relocation of a transmitter, installing a repeater or cabling from a location clear of interference.	Address via Environmental Management Plan	Check interruption during post construction monitoring of turbine operation	WCA	Immediately post construction	Actions recorded in EMP	Actions to comply with the Australian Broadcasting Association regulations
14	Potential for the turbines to be a hazardous object to aircraft safety	• Erect aircraft obstacle lighting and all other measures in accordance with CASA's directions • Liaise with the Aerial Agricultural Association of Australia regarding the wind farm location and potential hazards	Address following direction from CASA		WCA	During construction	Compliance with CASA direction	CASA regulations and recommendations
15	Blade ice injuring a person	• Restrict access to the turbines, • Erect warning signs, • Educate staff	Address via Environmental Management Plan	Operational staff to monitor during operations	WCA	During and post construction	Mitigation measures implemented	Maximise safety with respect to falling ice

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
16	Traffic delays during delivery and construction operations	• Notification of the local community, appropriate warning signs and traffic control will minimize any safety risk.	Address via Traffic Management Plan	Actions controlled via traffic officer during delivery and construction activities	Traffic consultant and construction contractor	Prior to construction period	Traffic Management Plan forwarded to RTA and Council for approval	Approval from RTA and Council that Plan is adequate
17	Driver distraction during operation of wind farm	• Erection of warning signs and development of viewing area to allow interested drivers to safely stop and observe the turbines	Address via Environmental Management Plan	Liaise with Oberon Council through out operation of the wind farm for changes in traffic impacts	WCA	Prior to construction period	Signs erected	Warn drivers of potential driver distraction
18	Generation of waste products	• prevention, • source reduction, • minimisation, • treatment, and • disposal (as a last resort).	Address via Waste Management Plan in Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities and on-going operations	WCA and construction contractor	Prior to construction	Measures implemented as listed in ECMP and EMP	Maximise recycling and reuse and minimise waste
19	Fire within the turbine	• Install fire extinguishers; • Liaise with local fire brigade	Address via Environmental Management Plan	Liaison with local fire brigade	WCA and construction contractor	Prior to construction	Measures implemented as listed in ECMP and EMP	Liaison with local fire brigade

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
20	Start a bushfire or contribute to bushfire threats	• Avoid contact of hot exhaust systems with dry and flammable vegetation • No smoking during construction activities • Bushfire mitigation measured planned to respond to bushfire threats • All vehicles to carry emergency communication equipment. • All vehicles to carry fire extinguisher or fire fighting equipment. • A 20m Asset Protection Zone should be established around each turbine. • Liaison with local RFS station	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and on-going operations	WCA and construction contractor	Prior to construction	Measures implemented as per ECMP and EMP	Protocols in accordance with RFS guidelines

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
21	Polarisation of community views regarding the wind farm	• Provide information via a mail out to the Black Springs community about the wind farm in the form of brochures/hand outs for schools, tourists and interested community groups, newspaper advertisements informing the local community about the proposal, and signage at a viewing location to inform the viewer about the wind farm and benefits of alternative energy. • WCA will establish a community benefit fund to actively pursue community investment opportunities, with the local school, tennis club and progress association, once the wind farm has been established.	Address via Environmental Management Plan	Actions controlled via environmental officer and WCA during operation of the wind farm	WCA	Prior to construction	Measures implemented as per EMP Record mail out in EMP	Ameliorate Community concerns
22	Cumulative impacts	• Ensure all mitigation options where necessary are implemented to reduce each individual impact	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and operation of the wind farm	WCA	Prior to construction period	Actions implemented as per EMP	Comply with mitigation measures
23	Construction works	• All construction works will be in compliance with the Department of Planning approval and undertaken in accordance with the ECMP	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and operation of the wind farm	WCA	Prior to construction period	Actions implemented as per EMP	Comply with Department of Planning approval and mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
24	Future site land use	• The wind farm will be constructed to allow for ongoing grazing and agricultural activities currently practiced on site to continue up the base of each turbine; • Landowners educated about operational dangers associated with the turbines (ie blade ice)	Address via Environmental Management Plan	Actions controlled via environmental officer during operation of the wind farm	WCA and land owners	Prior to construction	Actions implemented as per EMP	Safety measures implemented as per ECMP and EMP
25	Decommissioning	• Decommissioning of the wind farm will be in accordance with "best practice" requirements in place at the time of decommissioning; • All wind turbines and associated above ground infrastructure is to be removed and the site restored within 12 months of decommissioning; • Decommissioning and Site Restoration Plan to be submitted and approved by Department of Planning and Council prior to decommissioning	Address via Decommissioning and Site Restoration Plan	Actions controlled via environmental officer during decommissioning of the wind farm	WCA	Prior to decommissioning	Actions implemented as per Decommissioning and Site Restoration Plan	Decommissioning and Site Restoration Plan approved by Department of Planning and Council